

CONDENSED
CATALOGUES
OF
MECHANICAL
EQUIPMENT

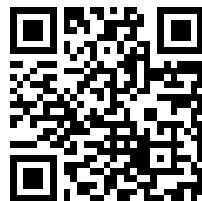
1915

THE AMERICAN SOCIETY *of*
MECHANICAL ENGINEERS

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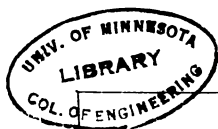
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CONDENSED CATALOGUES OF MECHANICAL EQUIPMENT

A COLLECTION OF CATALOGUE DATA CONCERNING
THE PRODUCTS OF MANUFACTURERS
OF MECHANICAL EQUIPMENT

and

THE MECHANICAL EQUIPMENT DIRECTORY
(CLASSIFIED)

Engineering Data from recent publications of the Society are included.

FIFTH ANNUAL VOLUME
OCTOBER 1915

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
29 WEST 39TH STREET
NEW YORK

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PREFACE

IN presenting the fifth annual volume of the *A.S.M.E. Condensed Catalogues of Mechanical Equipment*, the Society desires to call special attention to the following added features which appear for the first time in this edition.

1. The Engineering Data Section
2. The Section of Measuring and Testing Apparatus
3. The Enlarged Classified List of Mechanical Equipment

With two entirely new reference sections, and the many additional names of manufacturers which appear in the Catalogue Section and in the Directory Section, the 1915 volume of Condensed Catalogues becomes even more useful to the mechanical engineer and machinery user than it has proved itself to be during the four previous years of publication. Engineers, superintendents, managers, purchasing agents and other mechanical and executive heads of industrial plants will find the volume of great assistance for purposes of preliminary reference and as a source of specific and comparative information that would often be difficult to secure by any other means.

The value of this publication as a work of reference increases rapidly in direct proportion to its comprehensiveness, and manufacturers of mechanical equipment who are not represented by publication of their catalogue data are invited to avail themselves in future issues of the advantages of informative publicity afforded by the Condensed Catalogues.

Ten thousand copies of this volume are distributed gratis to mechanical engineers and machinery users, including the entire membership of the Society. The cost of compilation, printing and distribution necessarily involves a charge to manufacturers for publication of their catalogue data and for listings in the Classified Index. This charge, however, has been maintained at the lowest possible figure which will permit of publication of a work in keeping

DEC 20 1915

PREFACE

with the standards of the Society and the requirements of the field. The rate of \$70 for one page and \$50 each for additional page is so extremely reasonable, and the publicity value gained through representation is so great, that it is confidently expected that few firms of standing will fail to arrange for representation when the conditions are fully realized by the manufacturers in this field.

The acceptance and publication of catalogue data of manufacturers does not constitute in any sense an endorsement by the Society of firms and products thus represented in the volume of Condensed Catalogues; but every effort has been made to restrict the pages of the Condensed Catalogues to firms of good standing only, and all data presented has been carefully edited with a view to the elimination of advertising claims or exaggerated statements. In view of the large amount of material handled the Society cannot, however, accept responsibility for or endorse the assertions made by manufacturers concerning their goods.

Criticisms and suggestions are invited from users of the volume, to the end that subsequent annual editions may be made increasingly useful to the engineering profession and users of mechanical equipment in general.

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**CATALOGUE SECTION
PART I**

Power Plant Equipment

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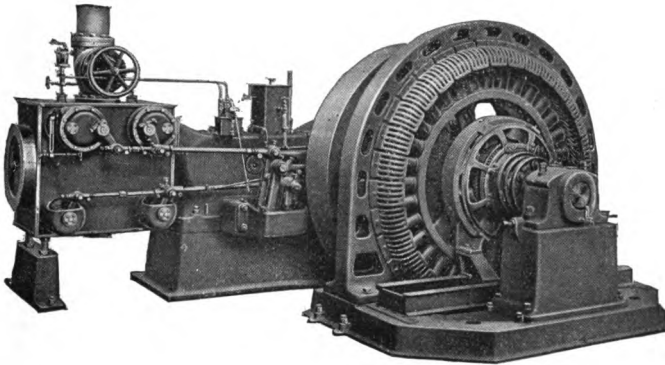
BALL ENGINE CO.

ERIE, PENNSYLVANIA

CORLISS-VALVE AND SINGLE-VALVE ENGINES; HORIZONTAL AND VERTICAL SIDE-CRANK ENGINES; TANDEM AND CROSS-COMPOUND SINGLE-VALVE ENGINES, CORLISS-VALVE COMPOUND AND SINGLE-CYLINDER ENGINES.

HIGH-SPEED CORLISS ENGINES

The feature which distinguishes this engine from other four-valve shaft governed engines is the patented non-detaching valve gear, which imparts the same movement to the valves that the drop cut-off of the slow-speed Corliss produces by picking up and dropping them. This permits the use of the best form of valve, and the valves are given the movement necessary for the greatest durability and tightness.



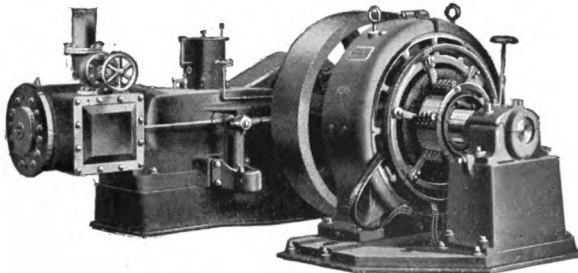
Horizontal Single Cylinder Side Crank Engine—Corliss Type

Built in sizes from 100 h.p. to 1200 h.p. in the single-cylinder and cross-compound types.

These engines excel in economy and regulation and are especially adapted for electric service.

SINGLE-VALVE AUTOMATIC ENGINES

These engines are the result of a long experience in building engines for electric service. They are superior in design and construction. The regulation and economy are the best of their type.



Single Cylinder Side Crank Engine—Single Valve Type

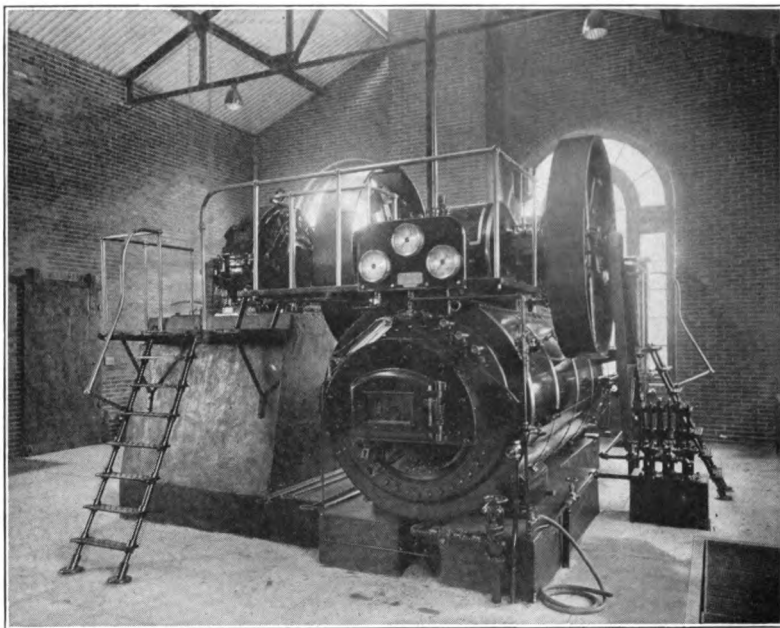
Built in sizes from 25 h.p. to 800 h.p. in the single-cylinder, tandem-compound and cross-compound types.



BUCKEYE ENGINE COMPANY

SALEM, OHIO

STEAM ENGINES, GAS ENGINES AND LOCOMOBILES



BUCKEYE-MOBILE

A High-Grade Self-Contained Power Plant of Universal Application

ECONOMY OF FUEL—From one to one and half pounds of coal (depending on the quality) produce a horse power hour, or a kilowatt hour is generated on $1\frac{3}{4}$ to $2\frac{1}{2}$ lbs. of coal.

EASY SUPERVISION—It is easily handled. The small quantity of fuel used reduces the labor of firing to a minimum. Every part is easily accessible.

USES ANY FUEL—The Buckeye-mobile is a universal fuel user. Steam coal of all grades, fuel oil, gas or refuse may be utilized by proper modifications of the furnace.

UNIVERSAL APPLICATION—It is suitable for all situations where a cheap reliable power is desired, such as electric stations, pumping plants, factories, office buildings, irrigation plants and flour mills.

DEPENDABILITY—Reliable operation is insured by its simplicity. There are but few moving parts and the nature of every element, for example, the removable corrugated furnace boiler, plain continuous tubular superheater, single piston valve engine, flanged valves, pipe fittings of steel and valveless vacuum pump, contributes to the very lowest maintenance and depreciation costs.

ECONOMY IN SMALL PLANTS—The usual small steam plant is notoriously wasteful of fuel. The Buckeye-mobile, however, even in the smallest sizes, produces power on less fuel than the largest compound condensing plants of the usual design using saturated steam.

TEST BEFORE SHIPMENT—Each machine is tested in the factory. The purchaser may witness the test and order the unit shipped only when all guarantees have been fully met.

Built in nine sizes from 75 H. P. to 600 H. P.

Complete information in Bulletin 112-B sent on request.

THE FITCHBURG STEAM ENGINE CO.

Established 1871

FITCHBURG, MASS.

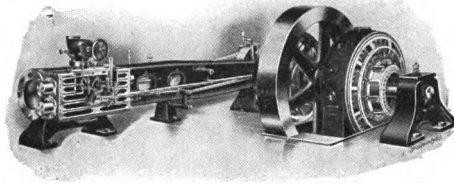
NEW YORK
PHILADELPHIA

BRANCH OFFICES
CHATTANOOGA

CHICAGO
SAN FRANCISCO

MANUFACTURERS OF STEAM ENGINES FOR USE UNDER EVERY
SORT OF CONDITION

"THE FITCHBURG"—DIRECT-CONNECTED—GIRDER BED

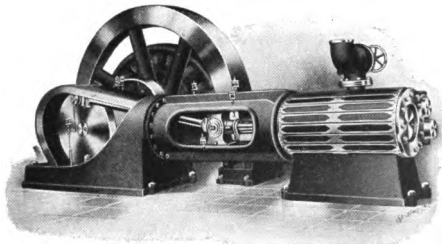


Sizes 7" by 18" to 22" by 42". Revolutions 80 to 250.

D. Con. or Belted Girder Bed as above	To 300 H.P.
" " " Tangye Bed as below	" 800 "
" " " Tandem Girder	" 300 "
" " " Tandem Tangye	" 800 "
" " " Cross Girder	" 750 "
" " " Cross Tangye	" 1500 "
" " " High-speed Horizontals	" 250 "
" " " Single Cylinder Vertical	" 400 "
" " " Steeple Comp'd Vertical	" 400 "

Details for any size given on application.

"THE FITCHBURG"—DIRECT-CONNECTED—TANGYE BED



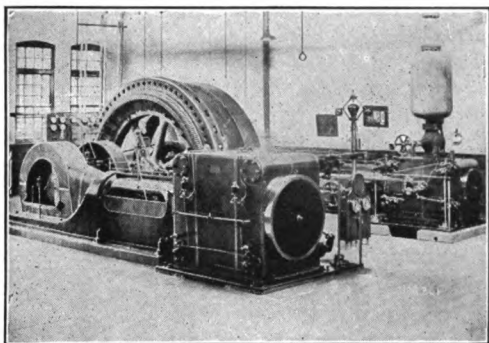
Sizes 12" by 18" to 30" by 48". Revolutions 80 to 250.

THE HOOVEN, OWENS, RENTSCHLER COMPANY

HAMILTON CORLISS ENGINE WORKS

HAMILTON, OHIO

CORLISS ENGINES, SLOW AND MEDIUM SPEED WITH RELEASING GEAR; CORLISS HIGH SPEED ENGINES WITH NON-RELEASING GEAR; HIGH DUTY PUMPING ENGINES; UNIFLOW AIR AND GAS COMPRESSORS; GAS AND "GASTEAM" ENGINES; BLOWING ENGINES; SUGAR MACHINERY AND SPECIAL CAST IRON AND SEMI-STEEL CASTINGS



HAMILTON CORLISS ENGINES: Built in simple, duplex, tandem compound, cross-compound, in both vertical and horizontal types, condensing and non-condensing. They can be adapted for any kind of service. Releasing gear types operate positively and noiselessly up to and including 160 R.P.M., while non-releasing gear types are built for a maximum speed of 200 R.P.M.

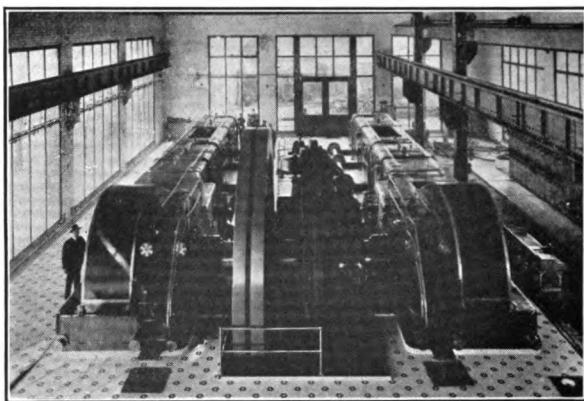
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HAMILTON PUMPING ENGINES AND PUMPS are built in both horizontal and vertical types, single and double acting; simple in design and economical in operation.

UNIFLOW COMPRESSORS: for either air or gas compression, tandem or opposed types. The most economical and efficient compressor being built. Mechanical drive for valves dispensed with entirely.

HAMILTON GAS AND "GASTEAM" ENGINES

are the most economical prime movers being built. Six 6,000 B. H. P. "Gasteam" engines are being built and installed in the new power plant of Ford Motor Company, aggregating 36,000 Brake Horse Power.



Give us a trial—Satisfaction will be your reward.
Offices in all large cities.

Write for bulletins.

McINTOSH & SEYMOUR CORPORATION

AUBURN, N. Y., U. S. A.

BRANCH OFFICES

NEW YORK CITY, 50 Church Street

ST. PAUL, 707 Commerce Building

CINCINNATI, 901 4th National Bank Building

PITTSBURGH, 1601 Arrott Building

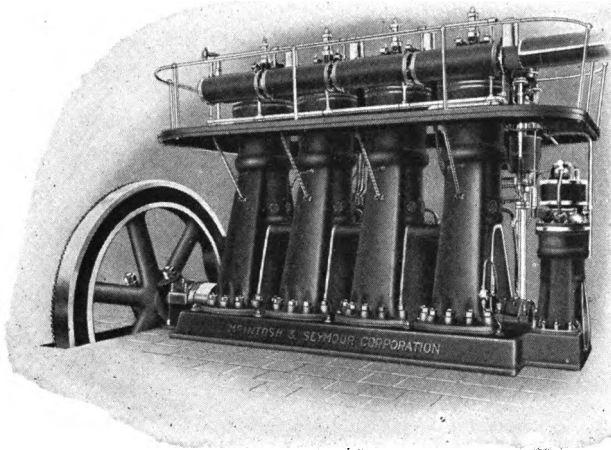
PHILADELPHIA, 131 South 24th Street

BOSTON, 94 Pearl Street

KANSAS CITY, 621 Delaware Street

CHARLOTTE, N. C., 800 Realty Building

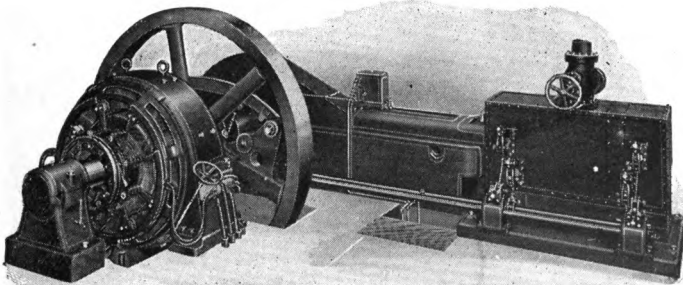
DIESEL TYPE OIL ENGINES AND STEAM ENGINES



McIntosh & Seymour Oil Engine, Type A, 500 Brake Horse Power

Our **OIL ENGINES** are built from the standard designs of the "Aktiebolaget Diesels Motorer." This Swedish Company has placed large numbers of these engines, both marine and stationary types, in highly successful operation throughout Europe.

These engines are built in a wide range of sizes and are adapted for mechanical drive or direct connecting to electric generators. Send for descriptive bulletins.



One of Two 150 Kw. Units in Madison Ave. Bldg., N. Y. City

McIntosh & Seymour **STEAM ENGINES** are known the world over for their excellence of design, materials and workmanship, economy, reliability and long life.

STEAM ENGINES IN SIZES FROM 25 TO 9000 HORSE POWER

NORDBERG MFG. CO.

MILWAUKEE, WIS.

ENGINEERS AND DESIGNERS OF HIGH EFFICIENCY
POPPETT VALVE ENGINES, POPPET UNIFLOW ENGINES; CORLISS EN-
DIESEL ENGINES, HIGH COMPRESSION OIL ENGINES, NORDBERG-CARELS
DIESEL ENGINES, AIR COMPRESSORS, BLOWING ENGINES, STEAM
AND ELECTRIC HOISTS, PUMPING ENGINES AND STEAM STAMPS

POPPET VALVE ENGINES

Nordberg Poppet Valve Engines operate with steam consumptions as low as 16 lbs. per H.P. hour non-condensing. These engines are of high speed design with new type of valve gear, and are built especially for use with high pressure superheated steam.

POPPET VALVE UNIFLOW ENGINES

These engines have Poppet steam valves, but exhaust through ports in the cylinder wall uncovered by the piston. A single-cylinder Uniflow Engine gives the same economy as an ordinary compound condensing engine.

CORLISS ENGINES

Nordberg Corliss Engines are built in all sizes with both the standard and Long Range valve gears.

HIGH COMPRESSION TWO CYCLE OIL ENGINES

This is the simplest oil engine on the market today. There are no valve gears or valves subject to the working pressure and heat. The only valve is a low pressure piston valve for scavenging air.

NORDBERG-CARELS DIESEL ENGINES

In large sizes up to and including 1500 H.P., the Nordberg Company build Diesel Engines under patents of Carels Freres, who have built more large Diesel Engines than any other company in the world.

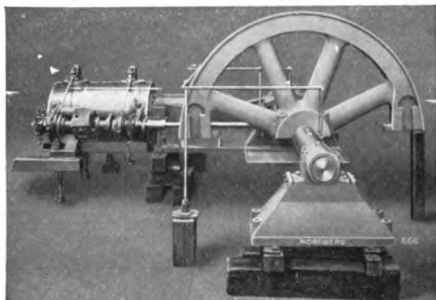
ELECTRIC HOISTS

Nordberg Electric Hoists are built from new designs throughout. The Nordberg drum, clutch and brake designs, developed in 25 years of experience with Nordberg Steam Hoists, have been incorporated in these designs.

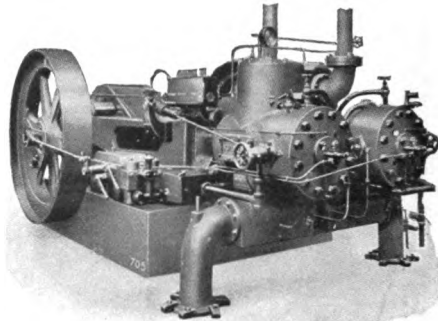
STEAM HOISTS

Nordberg Steam Hoists are well known to all mining men. Practically all of the large hoists for high speeds and great depths have been built by the Nordberg Co. All of the successful compound condensing steam hoists are of Nordberg make.

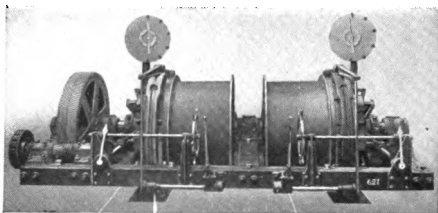
Bulletins on any products sent upon request.



Nordberg Poppet Valve Engine. The Valve Gear Opens and Closes the Valves Positively without the Use of Springs or Dash Pots, by Cams Oscillated by Eccentrics



Nordberg 200 H.P. High Compression Oil Engine, Twin Cylinder Design. The Simplest Engine for Direct Connection to Generators, Pumps, Etc., or for Belt Drive



Typical Nordberg Two-Drum Hand Operated Electric Hoist. The Axial Plate Clutches are Operated by a Worm Wheel and Sector and the Gravity Post Brakes by Hand Lever. Note Pointer Showing Position of Clutch

SKINNER ENGINE COMPANY

ERIE, PA.

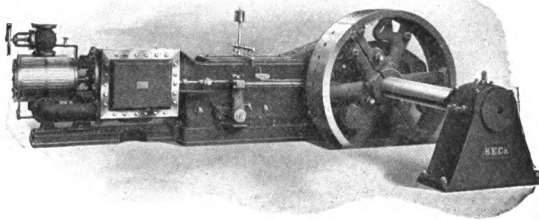
Branches in 33 Cities

BUILDERS OF HIGH GRADE AUTOMATIC ENGINES

SKINNER ENGINES

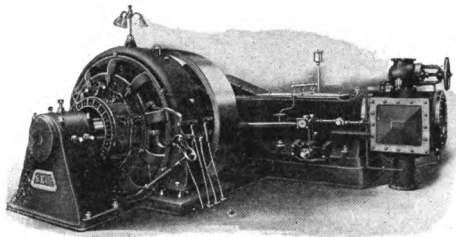
Side and Center Crank, Single Cylinder, Tandem and Cross Compound

All Skinner Engines are equipped with steam-tight valves, and therefore maintain their economy for years.



17

A single-valve Skinner Engine will give better economy after six months' operation than any High Speed Four-Valve.



The Skinner Double Eccentric Compound is more economical at half load than a high speed four-valve at full.

At full load, it is 20% more economical than the four-valve.

It pays its additional cost in six months time, and does this with only seven joints in the valve gear, as against twenty-nine in most four-valves.

These engines have made several American records for economy after a year's operation.

GENERAL ELECTRIC COMPANY

GENERAL OFFICE: SCHENECTADY, N. Y.

Branch Offices:

Atlanta, Ga.	Denver, Colo.	Los Angeles, Cal.	Providence, R. I.
Baltimore, Md.	Des Moines, Iowa	Louisville, Ky.	Richmond, Va.
Birmingham, Ala.	Detroit, Mich.	Memphis, Tenn.	Rochester, N. Y.
Boston, Mass.	(Office of Agent)	Milwaukee, Wis.	Salt Lake City, Utah.
Buffalo, N. Y.	Duluth, Minn.	Minneapolis, Minn.	San Francisco, Cal.
Butte, Mont.	Elmira, N. Y.	Nashville, Tenn.	St. Louis, Mo.
Charleston, W. Va.	Erie, Pa.	New Haven, Conn.	Schenectady, N. Y.
Charlotte, N. C.	Fort Wayne, Ind.	New Orleans, La.	Seattle, Wash.
Chattanooga, Tenn.	Hartford, Conn.	New York, N. Y.	Spokane, Wash.
Chicago, Ill.	Indianapolis, Ind.	Niagara Falls, N. Y.	Springfield, Mass.
Cincinnati, Ohio	Jacksonville, Fla.	Omaha, Neb.	Syracuse, N. Y.
Cleveland, Ohio	Joplin, Mo.	Philadelphia, Pa.	Toledo, Ohio
Columbus, Ohio	Kansas City, Mo.	Pittsburg, Pa.	Washington, D. C.
Dayton, Ohio	Knoxville, Tenn.	Portland, Ore.	Youngstown, Ohio

For Texas and Oklahoma business refer to Southwest General Electric Co. (formerly Hobson Electric Co.)—Dallas, El Paso, Houston and Oklahoma City.

For Canadian business refer to Canadian General Electric Company, Lt'd, Toronto, Ont.

COMPLETE ELECTRICAL POWER PLANT EQUIPMENTS AND SUPPLIES



The General Electric Company's monogram trade mark is known all over the world. It is the Guarantee of Excellence on Goods Electrical.

GENERATING APPARATUS

The Curtis turbine is built in all sizes from the smallest exciter set to the 35,000 Kw. size—the largest in the world. They are suitable for condensing or non-condensing service, and are also furnished in low pressure or exhaust steam, and mixed pressure types. The latter can be used with high or low pressure steam or both. Steam extraction turbines are furnished where exhaust steam is needed for heating or manufacturing purposes. Engine driven generators are regularly furnished in capacities ranging from 5 to 1,000 Kw. direct current and from 100 to 5,000 Kw. alternating current. Water wheel driven generators have been built in all desired sizes and voltages up to 10,000 horsepower at 11,000 volts. The General Electric Company has had more experience than any other company in building high voltage generators. These machines do not deteriorate in their windings and are very conservative in temperature ratings.

SYNCHRONOUS CONVERTERS—MOTOR GENERATORS

Synchronous converters and motor-generator sets provide an economical method for changing electric power of any standard frequency and voltage from alternating to direct current or vice versa.

SWITCHBOARDS

For all ordinary requirements the necessary panels can be selected from the G-E catalogs of Standard Unit Panels, and combined into a switchboard that will satisfy every requirement of the installation. The advantages of this method are convenience in ordering, prompt shipment and low price, the latter two resulting from the elimination of engineering and drafting on the individual order.

For high voltage plants and other cases where unusual requirements must be met, special switchboards are designed to meet any conditions of control.

Switchboard specialists are located at many of the principal offices of the company and will furnish data which will enable the engineer to specify a complete switchboard especially adapted to his particular requirements and with all parts built, assembled and tested as a unit by one company.

INSTRUMENTS—METERS

Switchboard and testing instruments and all kinds of electric meters cover fully the requirements for measurement of power.

REGULATORS

Automatic regulators are furnished for keeping the voltages constant on alternating or direct current power and lighting circuits.

GENERAL ELECTRIC COMPANY

TRANSFORMERS

Type H distributing transformers have unusually high factors of safety to ensure reliable service under the severest operating conditions, such as sleet, snow, lightning, overload, etc. The General Electric Company has standardized and carries in stock complete lines of these transformers in capacities 200 KV-A and less for potentials 6,600, 10,000, 13,200, and 33,000 volts.

G-E power transformers are built in sizes up to 15,000 KV-A and are operating very successfully on potentials as high as 140,000 volts. These transformers have superior features which ensure unusual ruggedness when operating under modern transmission conditions of high power and high potential where the strains due to abnormal current, voltage and frequency are unusually severe.

LIGHTNING-ARRESTERS

For alternating current circuits the aluminum arrester is recommended as giving the best protection attainable for station equipment.

For distributing transformers, the graded shunt resistance multiplex, or the compression chamber multiplex arrester may be used. The former is sensitive over a wide range of lightning frequencies and should be installed for protection of the larger transformers. The compression chamber arrester, lower priced and slightly less efficient, should be used to protect all the smaller transformers.

For direct current circuits two types of magnetic blowout arresters are available. Where a very high degree of protection is desired, aluminum arresters should be used.

WIRE AND CABLE

The General Electric Company manufactures wires and cables insulated with paper, varnished cambric, rubber or composite (graded) insulation. To meet different conditions of service these cables are furnished with protective coverings of cotton, asbestos, lead, band steel or wire armor.

LAMPS, INCANDESCENT AND ARC

Standard lighting units ranging from a 10 watt EDISON MAZDA lamp to the flame arc lamp for lighting large areas are carried in stock. Lighting specialists and illuminating engineers of the General Electric Company will assist in laying out any lighting system.

WIRING DEVICES

G-E Reliable wiring devices include panel boards, fuses, switches, terminals, insulators, etc. All these devices are N. E. C. standard.

MOTORS AND CONTROLLERS

ALTERNATING CURRENT MOTORS for 110, 220, 440 and 2,200 volts at all standard frequencies; constant or variable speed; for continuous or intermittent duty; hand or automatic control.

DIRECT CURRENT MOTORS for 115, 230, and 550 volts; slow or moderate speed; belt, chain, gear or direct drive. Constant, variable, or adjustable speed for continuous or intermittent duty. Suitable control for any service.

All motors are insulated for long life. Specially insulated motors for service in acid or alkaline vapors, excessive alkaline dust, or temperatures as high as 150° C. can be furnished.

The General Electric Company has a motor for every power application, large or small, a controller for every motor, and a specialist who can assist in the combined application to obtain the most satisfactory and economical results.

FLOW METERS

The General Electric Company has developed a practical device for measuring the flow of steam in pipes. The G-E Steam flow meter can be installed in any sized pipe at a small expense, and will give reliable readings of the flow. They are specially useful in the boiler plant and turbine room for measuring the output of the individual boiler and the input of the turbines. G-E Flow Meters are also furnished for measuring the flow of water, air and natural gas.

BULLETINS—FURTHER INFORMATION

Only a few of the products of the General Electric Company are described above. Bulletins, giving information, illustrations and full data on complete electrical apparatus for the power house will be mailed on application from our nearest office.



SOUTHWARK FOUNDRY & MACHINE COMPANY

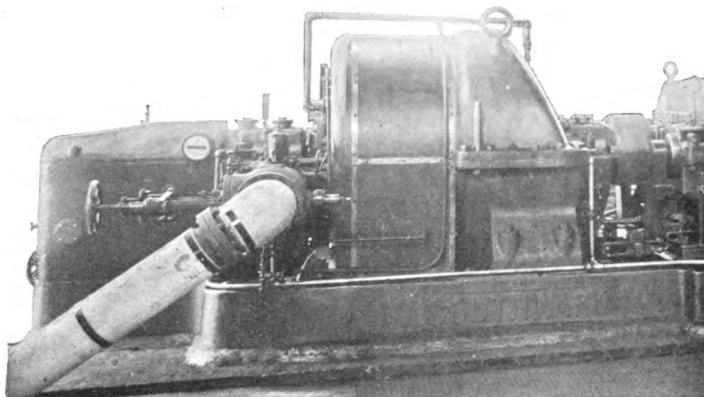
Founded 1836

PHILADELPHIA, PA.

**BUILDERS OF STEAM TURBINES, D. C. & A. C. TURBO-GENERATORS,
CENTRIFUGAL PUMPS, TURBO-BLOWERS AND COMPRESSORS for
Air and Gas, SURFACE AND JET CONDENSERS, HYDRAULIC AND STEAM
HYDRAULIC PRESSES, OIL ENGINES**

SOUTHWARK-RATEAU STEAM TURBINES

The Southwark-Rateau Impulse Steam Turbine is built in three types, high pressure, low pressure and mixed flow, made for alternating current or direct current service with the generators either direct or gear connected to the turbine. One of these types will effectively meet any power plant condition, insuring maximum efficiency and economy of production.



1500 Kw. High Pressure Turbine, Installed at the Sharon Steel Hoop Co.

There are no auxiliaries to be taken care of; nothing to oil; no pilot valves; no cataract cylinders; no balancing pistons; no close clearances; small floor space and installation cost.

The machine is of the simplest and strongest construction throughout, yet the simplicity is obtained without the sacrifice of economy. The economy is maintained over years of service.

CONSTRUCTIONAL FEATURES

- Buckets.....**Milled from solid alloy steel bar. Never wear out.
- Bucket Wheels...**Forged steel shrunk to shaft.
- Shaft.....**Heavy, short, and large in diameter so as to be safely below the first critical speed. Heat treated to insure maximum strength.
- Nozzles.....**Bronze or sheet steel for high or low pressure.
- Casing.....**Close grained gray iron, with steam passage scientifically designed to prevent eddy or friction losses.
- Accessibility.....**Top half of casing and diaphragm can be removed without breaking steam connections.



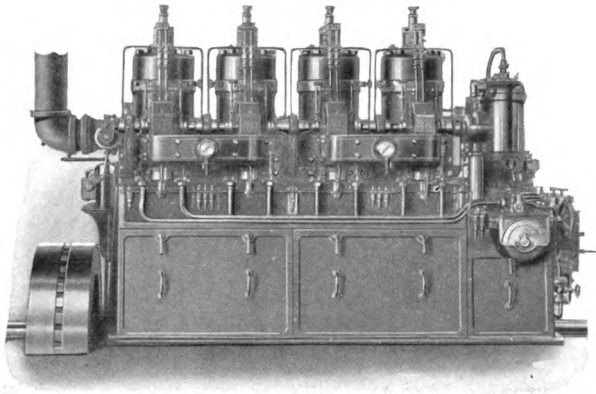
SOUTHWARK FOUNDRY & MACHINE COMPANY

SOUTHWARK-HARRIS VALVELESS ENGINE

(Diesel Principle)

For Marine and Stationary Use

This engine is of the 2-cycle type, built in 2, 4, 6 or 8 cylinder units, with multi-stage vertical air compressors, worked off the crank shaft. Entire control is by means of a single hand wheel, which through interlocking devices enables the engine to start on compressed air and gradually build up its operation on oil while still working on air. Also it can be started immediately with a load on or can be slowed down with equal certainty and greater ease than a steam engine of similar power. Built in sizes up to 1000 B.H.P.



**Southwark-Harris Valveless Engine, Installed on the
Yacht Southwark**

No. of cylinders, 4

Diameter of cylinders, 9 in.

Stroke, 13 in.

Weight, including fly wheel, 24,000 lbs.

Ignition, by temperature of compression

Revolutions per minute, 300

Fuel used, Crude or Fuel Oil

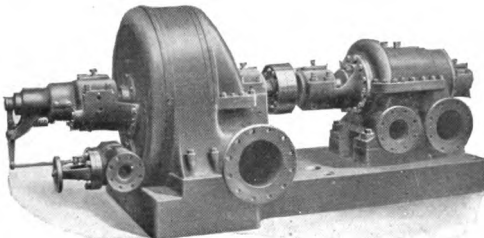
Air starting

Directly reversible

From Stone Cold to Full Power in 10 Seconds.

SOUTHWARK CENTRIFUGAL PUMPS

Built in single-stage, single-stage multi-impeller and multi-stage types, single or double suction, horizontal or vertical. We are prepared to supply turbine or motor driven centrifugal pumps made of cast iron, cast steel or acid proof metals to meet all conditions and for all services to which the centrifugal pump is adapted.



Turbine Driven 1200 G.P.M. Boiler Feed Pump

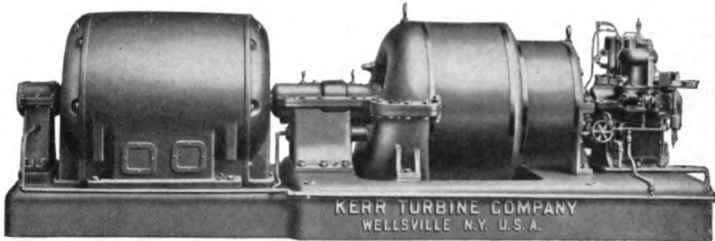
KERR TURBINE COMPANY

WELLSVILLE, N. Y.

Offices in all Large Cities.

'ECONOMY' STEAM TURBINES Driving Generators, Pumps, Blowers, Shafting, Etc., and **'ECONOMY' HERRINGBONE REDUCTION GEARS.**

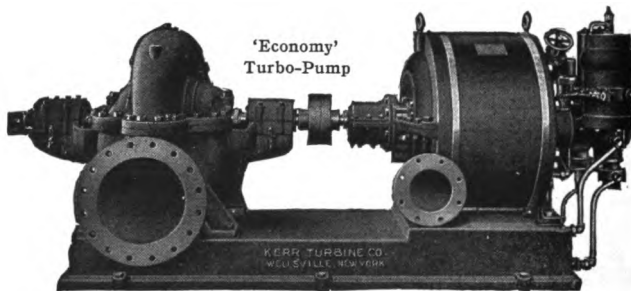
'Economy' Steam Turbines combine low first cost and minimum operation expense; require little floor space; are very economical in steam consumption; have practically no vibration, and require little or no attention or repairs.



750 K.W. 'Economy' Turbo-Alternator, Equipped With Oil Relay Governor

'Economy' Turbo-Generators, Pumps and Blowers have proven their superiority in nearly every industry—coal and metal mining, power and pumping plants (private and municipal), paper manufactories, glass making plants, steel plants, breweries, refineries, etc., as well as in Army and Navy use, marine installations, colleges, etc.

'Economy' Herringbone Reduction Gears have proven themselves to be the best, the quietest, the most accurate and the most efficient built in the United States. Aside from making possible the low steam consumption and faultless operation of geared **'Economy' Steam Turbines** driving low speed generators, pumps, blowers, and other machines, at their most efficient speed, they are also without equal for all classes of work requiring herringbone reduction gears. Recognition of their merit is shown by their installation on the U. S. S. MISSISSIPPI, U. S. S. PENNSYLVANIA, U. S. S. IDAHO, etc., as well as orders now on file from large pump builders, steel companies, etc., for **'Economy' Reduction Gears.** Specify **'Economy'** and protect your investment.



Send for Bulletins on
'Economy' Steam Turbines
'Economy' Geared Turbines
'Economy' Exhaust Steam Turbines
'Economy' Turbo-Pumps
'Economy' Turbo-Generators



Also our little book, "A System of Steam Turbines," which tells why we can make lower prices, better steam guarantees, and quicker deliveries.

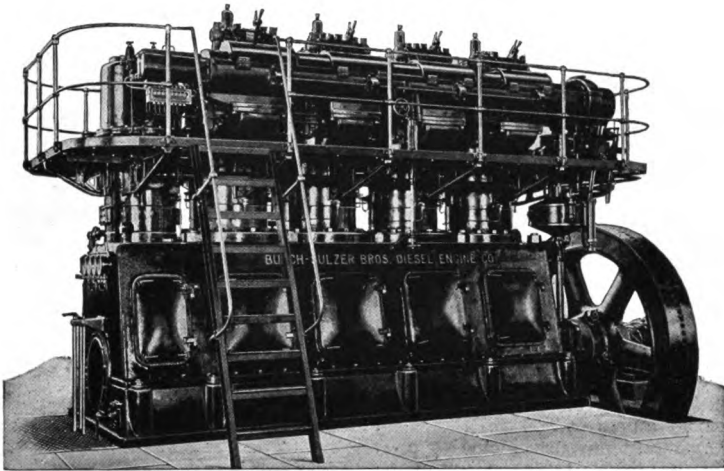
BUSCH-SULZER BROS.-DIESEL ENGINE CO.

ST. LOUIS, MO.

MINNEAPOLIS OFFICE, Plymouth Building.
HOUSTON, TEXAS, OFFICE, Carter Building.

SAN FRANCISCO OFFICE, Rialto Building.
LOS ANGELES OFFICE, San Fernando Building.

BUILDERS OF THE DIESEL ENGINE



The 4-B-125 Diesel Unit, 500 Brake Horse-Power



TYPE AND SIZES: Vertical, 4-cylinder design, single-acting, 4-stroke cycle, in sizes of 120 to 500 brake horse-power. These engines take precedence where continuous service and great economy of operation are required.

CONSTRUCTION: Reliability, continuous efficiency, minimum depreciation and great economy in operation constitute the fundamentals upon which the design of our engine was based. Our engines are manufactured in a new, modern plant, with all tools selected to meet the requirements. Having been in the business of building DIESEL engines since their commercial development began, we can offer you a type best calculated to meet your conditions, guaranteeing you accuracy, finish, the interchangeability of duplicate and wearing parts, and time-tried design.

ADVANTAGES: All in one room, directly under the eye and hand of one man. No boiler room. No stack. No coal bins, no ash heap. No dirt, no dust; no shut-down for coal strikes. No explosions, inspection, cleaning or repairs of boilers. No engineers' licenses and no firemen. No lubricating difficulties. No fuel lost in transit, no depreciation in storage, and no handling. No carburetor, vaporizer, hot-bulb, tube or electrical ignition apparatus. No explosions, no shocks. No banked fires. No standby losses. No preliminary heating up. Perfect regulation, unexcelled economy and the highest thermal efficiency known.

BULLETINS: We publish descriptive illustrated bulletins on our engine; a bulletin on the Acceptance Test and Operating Costs of plants in Texas, a Test with curves on a plant in Oklahoma, a Reprint of an Arizona Corporation Commission Report on the operation of DIESEL engines in Arizona, a Paper by Tait-Nordmeyer Engineering Co. on the Comparative Economy of DIESEL and Steam Operated Raw Water Ice Plants; and others.

Let us know your power problem and we will send you pertinent bulletins and help solve it for you. It will pay you to examine our proposition carefully before you buy any power equipment.

FULTON IRON WORKS

Established 1852

Incorporated 1871

MAIN OFFICE AND WORKS, ST. LOUIS, MO.

**BUILDERS OF FULTON-TOSI OIL ENGINES DIESEL SYSTEM, CORLISS
AND MEDIUM SPEED STEAM ENGINES**

FULTON-TOSI OIL ENGINES

(Diesel Type)

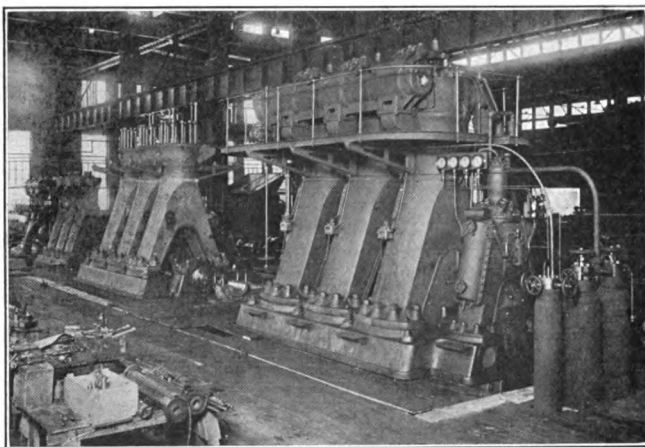
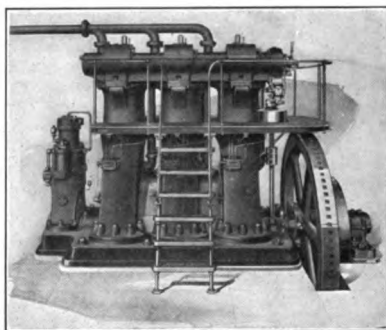
The Fulton-Tosi Four-Cycle Oil Engine is built in the vertical form, "A" frame, and in two, three and four cylinder arrangement. The engine is designed to operate on the cheapest petroleum, crude or fuel oils, or tar oils, with greatest reliability and economy, and as ignition is insured by the heat of compression, no hot bulb, electric spark, or other exterior means of ignition is required.

The engine may be started up from cold within one minute, without any troublesome or time consuming preliminaries.

The operation of the engine is comparatively quiet, very clean and perfectly safe, permitting of its installation almost anywhere. Tanks for the storage of fuel oil may be buried under buildings, drive ways, or in any other convenient location, without interfering with the use of the space above for other purposes.

The Fulton-Tosi Four-Cycle Oil Engine is built in sizes ranging from 100 B.H.P. in two cylinders to 800 B.H.P. in four cylinders. These engines are suitable for any power purpose, including electric light and power plants, water works, flour mills, textile mills, irrigation plants, etc. Where the requirements as to regularity of speed are extremely exacting, we recommend the selection of an engine with at least three cylinders.

Bulletin 800 giving details will be gladly forwarded upon request.



Diesel Engine Erecting Floor

FULTON-CORLISS ENGINES: "Fulton Corliss" Steam Engines are built in all types and sizes up to 300 H.P. For engines of a higher speed than the limit of Corliss engines with releasing gear, we also build the Fulton Four Valve Side Crank Engines which maintain the high efficiency for which the "Fulton Corliss" is noted.

"Over sixty years of successful manufacturing"



DE LA VERGNE MACHINE CO.

1123 EAST 138TH STREET, NEW YORK CITY

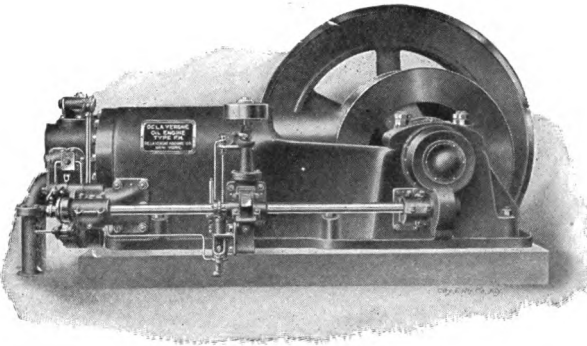
DE LA VERGNE CRUDE OIL ENGINES
REFRIGERATING MACHINERY

ICE MACHINES

TYPE "FH" CRUDE OIL ENGINE

De La Vergne oil engines have been developed over a period of 20 years in the United States to meet American conditions.

They operate on the lowest grades of crude oil and also on waste residual tar by-products which cannot be economically used in any other known way. This ability to operate on the cheapest grades of fuel together with their remarkably high economy makes the De La Vergne oil engine the most economical form of power known.



Single Cylinder Engine

They are of the medium pressure type and the wear and tear caused by high compression and explosion pressures are entirely eliminated. Every part is within easy reach from the floor and the design is distinguished by its few parts and remarkable simplicity throughout.

Skilled engineers are not required and the engine operates with only ordinary attention.

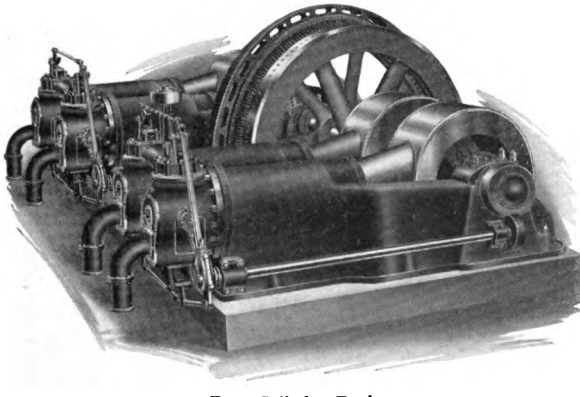
Guaranteed—to operate on any commercial fuel or crude oil produced in the United States or in Mexico, to develop 19 B. H. P. hours per gallon of fuel when running at $\frac{3}{4}$ to full load.

Advantages—no excessive pressures, low cost of operation, no standby losses, no handling of coal or ashes, absolute reliability, minimum expense for attendance and upkeep.

Application—electric lighting, pumping, air compressors, refrigerating machines, factory service, mining, etc., in fact, any place where power is required.

Sizes—Built in one, two and four cylinder units from 65 B. H. P. to 800 B. H. P.

Full details in bulletin No. 138—sent on request.



Four Cylinder Engine



NATIONAL METER COMPANY

Established 1870

84-86 CHAMBERS ST.

NEW YORK CITY

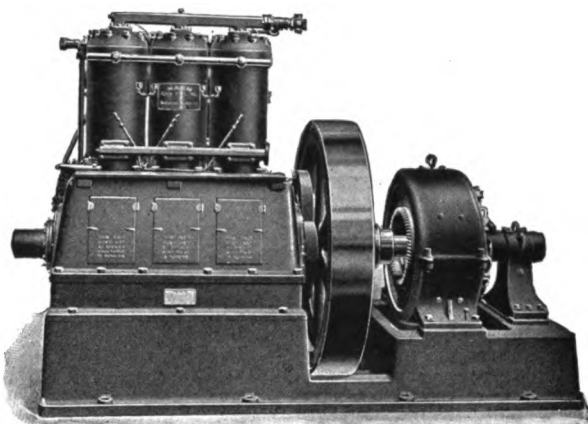
MANUFACTURERS OF WATER METERS AND GAS ENGINES

NASH GAS ENGINES

To Operate on Illuminating Gas, Gasoline or Producer Gas
Simple, Silent, and Efficient

The engine throughout is the embodiment of the latest and best ideas of gas engine design and construction.

Is of very liberal proportions and high grade in every detail. The NASH has many exclusive and valuable features.



All sizes of NASH engines are of the four cycle type and are fitted with throttling or hit and miss governors as may be selected or best suited to the conditions.

The National Meter Company is the originator of the throttling governor for gas engines and the NASH was the first gas engine to be equipped with it.

In regulation, the NASH Gas Engine is on a parity with that of the best steam engines.

Due to its high economy, closeness of regulation and quietness of operation it meets a great range of power requirements.

Manufactured in all sizes from 12 to 300 H.P.



COMPARATIVE COST OF POWER OF VARIOUS TYPES OF ENGINES

TYPE OF ENGINE	Fuel	Price	Fuel Consumed per B. H. P. per Hour	Cost per H. P. per Hour	Cost 100 H. P. 10 Hrs.
Simple Slide Valve Steam.....	Bituminous Coal	\$3.50 per ton	8 lbs.	.0124	\$12.40
Compound Condensing Corliss.	Bituminous Coal	3.00 per ton	3 lbs.	.0045	4.50
Steam Turbine.....	Bituminous Coal	3.00 per ton	3 lbs.	.0045	4.50
Oil Engine.....	Fuel Oil	.036c. per gal.	1/12 gal.	.003	3.00
Nash Gas Engine.....	Natural Gas	25c. per M.	10 cu. ft.	.0025	2.50
Nash Gas Engine on Producer Gas.....	Coke	5.00 per ton	1 1/4 lb.	.0031	3.10
Nash Gas Engine on Producer Gas.....	Lignite	1.75 per ton	2 lbs.	.00175	1.75
Nash Gas Engine on Producer Gas.....	Anthracite Buck	4.00 per ton	1 lb.	.002	2.00
Nash Gas Engine.....	Illuminating Gas	75c. per M.	18 cu. ft.	.0135	13.50
Nash Gasoline Engine.....	Gasoline	16c. per gal.	1/10 gal.	.016	16.00
Electric Power.....		3c. per KW hr.		.0225	22.50

THE OTTO GAS ENGINE WORKS

MAIN OFFICE PHILADELPHIA WORKS

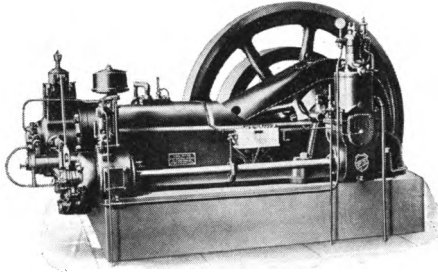
NEW YORK

CHICAGO

MANUFACTURERS OF GAS, GASOLINE, ALCOHOL, DISTILLATE AND OIL ENGINES; PRODUCER GAS PLANTS

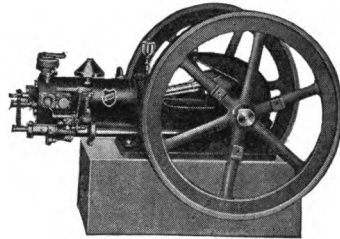
OTTO HORIZONTAL CRUDE OIL ENGINES (DIESEL PRINCIPLE)

Made in sizes from 35 H.P. up. These engines will operate with high reliability, efficiency and uniformity on the heaviest, most viscous crude oils, or on lighter oils, such as kerosene, naphtha, etc. Service records covering long periods show an average fuel consumption of only $1/15$ gallon per brake horsepower hour—equivalent to an expense of $1/4$ cent at current fuel prices. These engines start by low pressure air (which they compress themselves) and, operating on the Diesel principle, no ignition system is required. Full information or engineering coöperation on request.



OTTO GAS, GASOLINE AND ALCOHOL ENGINES

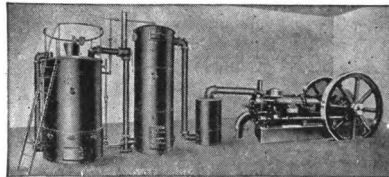
Otto Engines are made to operate on illuminating, natural or producer gas, gasoline, alcohol or distillates. They embody all the basic principles developed by Dr. Otto, and since 1876 have been undisputed leaders in the internal combustion engine field. Their remarkable mechanical and economic success is reflected in sales exceeding 100,000 engines. These engines are available in sizes from 2 to 300 H.P., and all the more frequently used sizes are carried in stock for immediate shipment.



We have thousands of test reports covering these engines, with every conceivable light-body fuel. We will gladly send these, or printed matter, on request, and coöperate with you fully in an engineering way.

OTTO SUCTION GAS PRODUCERS

They convert the heat of anthracite coal, charcoal or coke into producer, or semi-water, gas. This contains CO and H with a heat value of about 140 B.T.U. per cu. ft. The efficiency at the engine is exceedingly high, and fuel cost, very low. A brake horsepower hour at no more than one and one-quarter pounds of fuel is guaranteed, while the actual consumption generally does not exceed one pound.



These engines and plants are absolutely safe and have the unqualified approval of the underwriters.

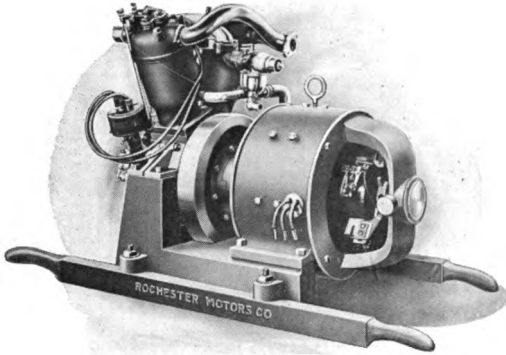
Printed Matter on any type of Otto product will gladly be mailed if the general requirements are stated.



ROCHESTER MOTORS COMPANY, INC.

ROCHESTER, N. Y.

**SPECIALIZE IN GASOLINE ELECTRIC GENERATING SETS.
ELECTRIC MOTORS FOR SPECIAL APPLICATION**



**2 K.W. Portable Set, Water-Cooled. Made also with
Air-Cooled Cylinders**

COMPACT
33"x18½"x24" high

LIGHT WEIGHT
400 lbs. without skids

EFFICIENT
.8 pints gasoline per
engine H.P. Hour

IGNITION
Atwater Kent or
Magneto

28

ROCHESTER GENERATING SETS are provided with sensitive governors acting directly upon the throttle which in connection with the dynamo compounding gives the same voltage at full load as when running idle.

ROCHESTER DYNAMOS are of the multipolar commutating pole type with steel frames, ball bearings and windings impregnated to resist oil and dampness.

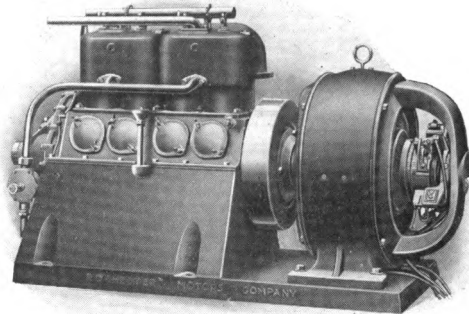
The engine parts subject to wear or strain are of the most suitable material and scientifically heat treated.

Being built in the same shop and not simply assembled there is no divided responsibility.

SMOOTH RUNNING
Crank shaft, flywheel, etc.
are given a running
balance

LONG LIFE
Good design, best materials, finest of
workmanship

SERVICE
Engine and Dynamo
made to work together



4 Cylinder Generating Sets. 3 to 13 K.W.

LIGHTING PLANTS for SHIP, YACHT, COUNTRY HOME, TRAVELING SHOW, CONTRACTOR, etc.

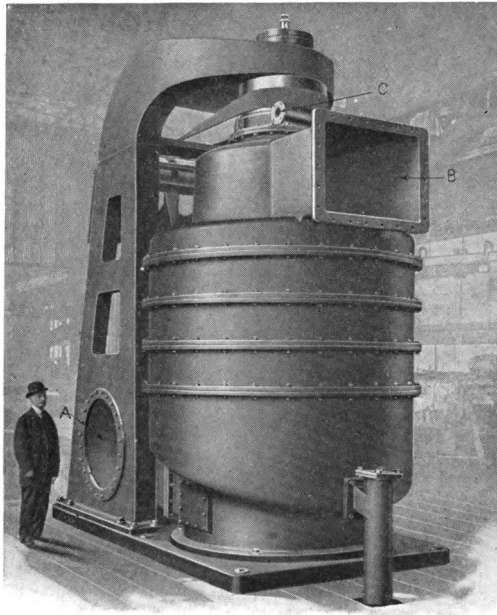
THE COAL & COKE BY-PRODUCTS CO.

421 Wood St., PITTSBURGH, PA.

MANUFACTURERS OF THE "ERNST" PATENTED GAS CLEANING APPARATUS. CONTRACTORS FOR COMPLETE GAS POWER PLANTS AND GAS CLEANING PLANTS

"ERNST" GAS CLEANING APPARATUS

**Patented August 18th and September 29th, 1908. Other Patents Pending
PATENTS HAVE BEEN SUSTAINED IN U. S. A. COURTS**



E. No. 2 Our Largest Machine 9000 Cu. Ft. Gas per Min.

BITUMINOUS PRODUCER GAS AND BLAST FURNACE GAS CLEANED FOR GAS ENGINE AND FUEL PURPOSES: Mechanical washing has been recognized to be the most reliable and effective method of cleaning gas.

The machine is simple in construction, **self cleaning**, requiring practically no attention during operation, giving **perfect and continuous operation** with **smaller power and water consumption** than in any other apparatus.

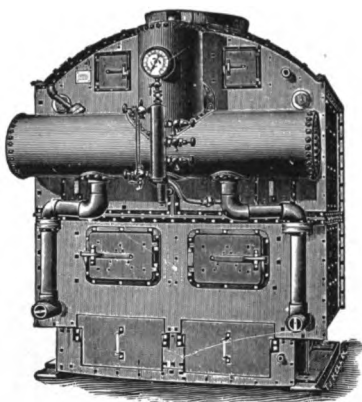
CAPACITY: The machines are built in single units of from 500 H.P. to 5,000 H.P. each or 1000 cubic feet to 9000 cubic feet gas per minute.

INQUIRIES: With inquiries state if for new or existing plant, the capacity of plant, kind of gas to be cleaned and if producer, type and coal used, also nature of service.

ALMY WATER TUBE BOILER CO.

PROVIDENCE, R. I.

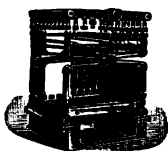
SECTIONAL WATER TUBE BOILERS FOR EVERY MARINE PURPOSE



Exterior—Class B, C, D

30

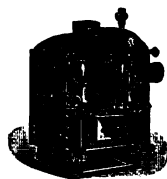
The Almy Boiler is in every respect a Pipe Boiler being constructed of Extra Strong Iron Pipe and Malleable Iron Fittings. As the threads are standard size, repairs may be made conveniently in almost any part of the world. Due to design, expansion and contraction is entirely taken care of and sudden change of temperature has no bad effect on the heating surface. 75 lbs. to 100 lbs. of steam may be raised from cold water within seven minutes with perfect safety.



Interior
Class A, B, C

We build six classes or types of boilers—A, B, C, D, E and Z. Type is determined according to the desired duty. Sizes run from 2.7 to 56 sq. ft. of grate surface and 87 to 2,000 sq. ft. of heating surface.

An evaporation of 11.92 lbs. of water from and at 212° per pound of combustible has been shown on a 45 H.P. boiler—rate of combustion 14 lbs. per square foot of grate surface per hour. The same boiler under forced draft evaporated 7.89 lbs. of water per pound of coal—gage pressure 153 lbs., feed temperature 56°, rate of combustion 35.98 lbs. of coal per square foot of grate surface per hour.



Exterior
Class A

The large amount of fire box heating surface receiving direct heat is an important feature. In our class D and E boilers, there is 90% more of such heating surface than in a flat sided fire box of equal dimensions.

These boilers are very satisfactory with oil burners as quite a number of installations on the Pacific Coast have proved.

Our business is principally marine but we occasionally furnish boilers for stationary use. "Knocked down" boilers may be shipped in 400 lb. packages and under.

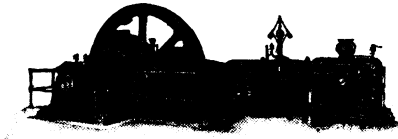
Catalogue containing full description of construction will be sent on application.



THE BASS FOUNDRY & MACHINE CO.

FORT WAYNE, IND.

ESTABLISHED 1853



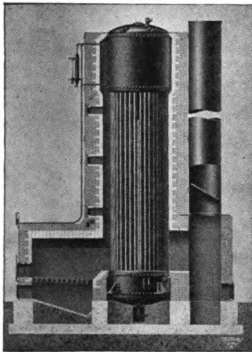
Corliss Engine

HEAVY DUTY AND GIRDER FRAME CORLISS ENGINES

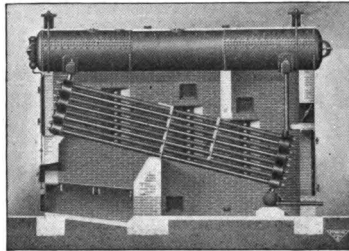
for

Factory, Rolling Mill and Direct
Connected Service

Built in simple, tandem com-
pound and cross compound types.



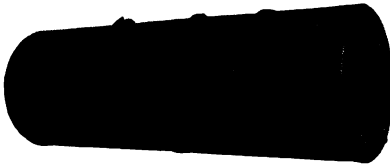
Vertical Water Tube Boiler



Horizontal Water Tube Boiler

HORIZONTAL AND VERTICAL WATER TUBE BOILERS

In Sizes from 50 to 1000 H.P.



Horizontal Tubular Boiler with Longitudinal
Seams, Butt Joint, Quadruple Riveted

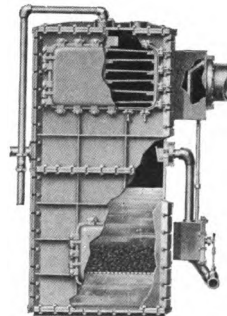
HORIZONTAL TUBULAR BOILERS

ALL BOILERS BUILT IN ACCORDANCE
WITH A. S. M. E. BOILER CODE

We also manufacture

TANKS, STACKS, STAND PIPES AND
STEEL PLATE WORK OF ALL KINDS.
HEAVY DUTY PISTON VALVE EN-
GINES, HEAVY ROPE WHEEL DRIVES,
CAR WHEELS AND GREY IRON CAST-
INGS OF EVERY DESCRIPTION.

IRON AND STEEL FORGINGS.



OPEN FEED WATER HEATERS

Both Horizontal and
Vertical

Either cast iron or steel
construction.

Built in all sizes.

EDGE MOOR IRON COMPANY

EDGE MOOR, DELAWARE

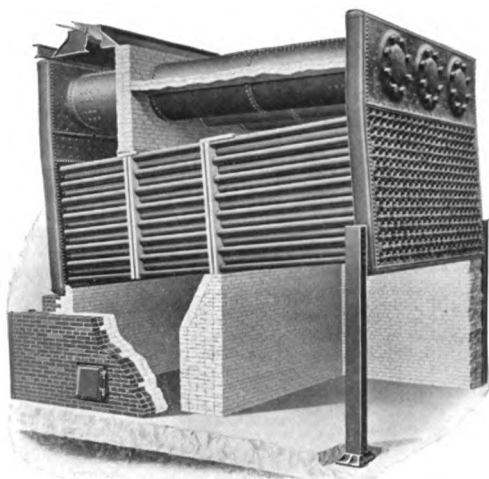
111 Broadway
NEW YORK

79 Milk Street
BOSTON

10 S. La Salle Street
CHICAGO

Rialto Building
SAN FRANCISCO

BUILDERS OF THE EDGE MOOR WATER TUBE BOILER



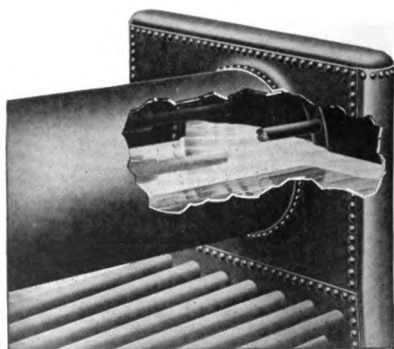
Note the special header construction, the horizontal drums, the elliptical handholes, the steel supports, and the efficient manner of baffling

When a boiler is desired for the exacting service of a modern power plant, the square feet of heating surface and the strength of parts are not the only important factors to be considered. While a boiler appears to be a simple piece of apparatus structurally, its internal performance is far more complex than is generally realized, and it is this complex action that warrants more attention to the details of design.

of the Edge Moor boiler cannot be explained in the limited space of an advertisement. Those interested in steam boilers and in tests of unusual performance should send for our illustrated bulletins. They will also do well to ask for preliminary information from one of our sales offices before preparing the final specifications for a proposed plant, for by doing so, they will obtain valuable suggestions without any obligation.

Edge Moor boilers are built in sizes from 100 to 1000 horse-power.

Write our nearest office.



The header construction provides such an increased steam liberating area that boilers can be safely and efficiently forced to several times rated capacity

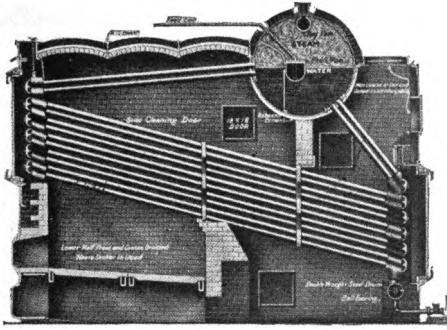


FLANNER WATER-TUBE BOILER CO.

AKRON, OHIO.

THE TAYLOR-PEARSONS MERCANTILE STAFF, Northeastern Mgrs., 70 FIFTH AVE., N.Y.

THE FLANNER WATER-TUBE BOILER



Cross Sectional Side Elevation

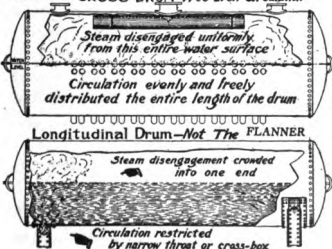
THE FLANNER WATER TUBE BOILER has the greatest amount of heating surface per square foot of floor space, and takes less head room than any other type of water tube boiler, which features make it extremely adaptable where space is a consideration. It is built in units from 100 to 2,000 H.P., and is especially adapted for central power stations and all kinds and conditions of work. It can be arranged for any type of Automatic Stokers.

FLANNER DOUBLE CAPACITY FLOWED STEEL HEADERS are hung by pendulum rods and suspended from heavy steel frames thereby eliminating the stress of contraction and expansion. Illustration shows a header with the tubes rolled in place forming a SECTION. It also shows the inside cap covering four tubes. This method of grouping the tubes in sets of four enables us to use one hand-hole plate for every four tubes. This reduces the openings 75% which materially reduces the cost and increases the ease of cleaning.

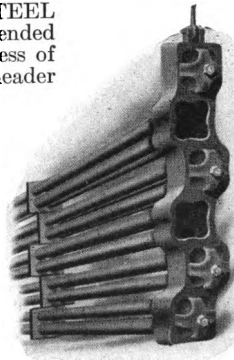
Circulation

This illustration shows the free and easy circulation of the FLANNER CROSS DRUM TYPE as compared to a throttled water-leg or any other type where a longitudinal drum is used. In the FLANNER the steam is evenly distributed the entire length of the drum whereas the other types have a choked circulation due to the water-leg construction.

FLANNER CROSS DRUM—Free Even Circulation

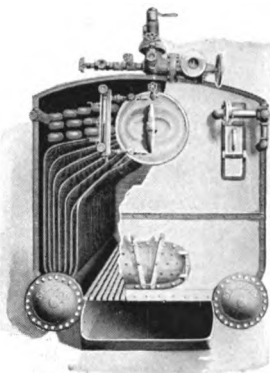


THE FLANNER TYPE has FOUR CIRCULATING TUBES entering and delivering dry steam from each header into the steam drum thereby giving twice the steam discharge area of any other design of boiler, which produces better circulation, and does away with any pounding or foaming, as in the longitudinal type and insures for the Flanner a normal water line under any and all conditions.



GAS ENGINE & POWER CO. AND CHARLES L. SEABURY & CO., CONS.

MORRIS HEIGHTS, NEW YORK CITY
STATIONARY AND MARINE BOILERS AND ENGINES



THE SEABURY WATER-TUBE BOILER

For All Pressures up to 350 Lbs.

DO NOT WRECK THE BUILDING TO REPLACE THE BOILER—The Seabury Water Tube Boiler can be installed in a minimum of space, making it particularly desirable for Office Buildings and Hotels. Is "self contained" requiring no elaborate brick or structural supports. Adapted for anthracite, bituminous, wood or oil fuels.

Description: The Seabury Water Tube Boiler is built for safety, durability, maximum heating and grate surface combined with minimum dimensions. These features are obtained by the use of the best

obtainable materials—for instance, steel for water drums and tube plates having tensile strength from 55,000 to 60,000 pounds, and solid, drawn steel tubes.

Convenient and adequate facilities are provided for keeping the tubes free from damp ashes and soot on the outside, and to easily clean scale and grease from the inside. The heating surface is greater in these boilers than in any others for the same number of cubical feet of boiler casing. The circulation of water is perfect, and a steady water level is always maintained. Expansion and contraction are provided for, the tubes having a sufficient bend to enable them to come and go with heating and cooling without straining the joints at the ends.

The furnace is surrounded by rows of water tubes so bent and arranged as to leave ample passages for the gases as well as to provide necessary baffling. The tubes are expanded into drilled holes in steam and water drains. *There are no screw joints subject to the intense heat of the combustion chamber.* Over the nests of tubes, on both sides of the steam drum, is located the feed water heater through which the water passes before entering the drum. This heater is constructed of steel pipe and malleable iron return bends, and between heater and drum is interposed a check valve.

The boiler is cased in a substantial sheet steel jacket stiffened with angles on the outside and lined on the inside throughout with magnesia and asbestos, except the ends of the combustion chamber, which are lined with fire brick. The casing is fitted with all necessary fire and cleaning doors.

The large combustion chamber in a Seabury Boiler makes it very successful for oil burning.

DIMENSIONS, STOCK SIZES

Length Casing	Width Casing	Hgt. Inc. Crown and Ashpan	Grate Surface	Heating Surface
30	34	49	3.5	120
44	36	61	4.94	222
48	54	64	9.5	333
58	60	82	12.25	516
55	46	58	8.48	307
72	51	72	12.9	521
78	68	75	21	750
81	92	96	33.4	1087
91	98	100	41	1310
88	106	103	39.5	1649
96	124	118	53.75	1920
119	135	131	77.57	2846
124	87	105	45	1940
130	87	119	44.77	2152
Special type			52	1650
			101	3300

The following fittings are included: Water column complete. Three (3) water gauge cocks. One (1) soot blower. One (1) set of firing tools. Whistle connection. Safety valve. Two (2) blow-off cocks. One (1) grate shaker. Feed check valves. Connection for main steam and auxiliary steam.

All boilers except first two require jet or forced draft to develop full engine power.

Sizes suitable for natural draft on application.

E. KEELER COMPANY

Established 1864

WILLIAMSPORT, PA.

NEW YORK PHILADELPHIA PITTSBURGH CHICAGO CLEVELAND DALLAS SAN FRANCISCO

WATER TUBE, TUBULAR AND MARINE BOILERS. STEEL PLATE WORK

WATER TUBE BOILERS

Standard Type

The arrangement of furnace, tubes, headers and drum in the Keeler Water Tube Boiler is efficient, accessible and compact. The superior efficiency of the Keeler Boiler rests upon correct proportions of heating and grate surface for the character of fuel to be burned, ample height of furnace, a superior arrangement of baffle walls and a perfect circulation. Every portion of the heating surface is accessible for both external and internal inspection, making it impossible for soot or scale to accumulate undetected. There is ample room between tubes and drum for inspection or repairs. Special side cleaning doors make it possible to observe the condition of the outside surface of the tubes. There is no part of the interior surface that cannot be examined and cleaned.

Keeler Water Tube Boilers are usually built complete and tested in the shop. This reduces the cost of erection, as the boilers are handled as a unit. It also eliminates the dangers due to careless assembling of boilers in the field and makes the erection merely a matter of placing in position and attaching fittings.

Built in units 75 to 1500 H. P.

WATER TUBE BOILERS

Cross Drum Type

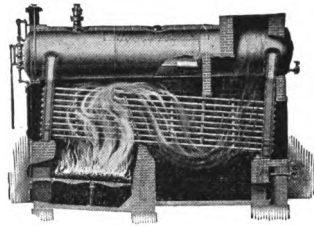
The Keeler Cross Drum Water Tube Boiler is a modification of the standard design, only in the length and location of the drum and the method of connecting it to the headers. This type was developed to meet the demand for a high grade water tube boiler that could be installed in Office Buildings, School Houses, Churches, Apartment Houses, Hotels and boiler rooms generally where ceiling height is limited or where the boiler must be introduced through narrow passageways or restricted openings.

The pressure parts of the boiler are shipped in a knocked down condition, making it possible to install it without cutting through walls and floors in locations that would be wholly inaccessible for almost any other type of boiler. If boilers are to be exported, the cross drum boiler can be handled at much less expense by steamship companies on account of its reduced bulk in a knocked down condition, and the comparatively small weight of the heaviest piece.

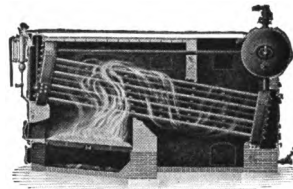
Built in units 60 to 600 H. P.

HORIZONTAL RETURN TUBULAR BOILERS

Our Return Tubular Boiler is the product of fifty years' experience of boiler building. Tube holes are drilled from the solid plate, and not punched small and reamed to size. All seams are thoroughly caulked on the outside, and the end of butt straps are caulked on the inside. Braces are drop forged. Steam outlets, man hole plates, yokes and brackets are of pressed steel.



Standard Type Water Tube Boiler



Cross Drum Type Water Tube Boiler



Horizontal Return Tubular Boiler



FIFTY YEARS OF BOILER BUILDING

Ask for Catalogs

THE GEORGE T. LADD CO.

GENERAL OFFICES

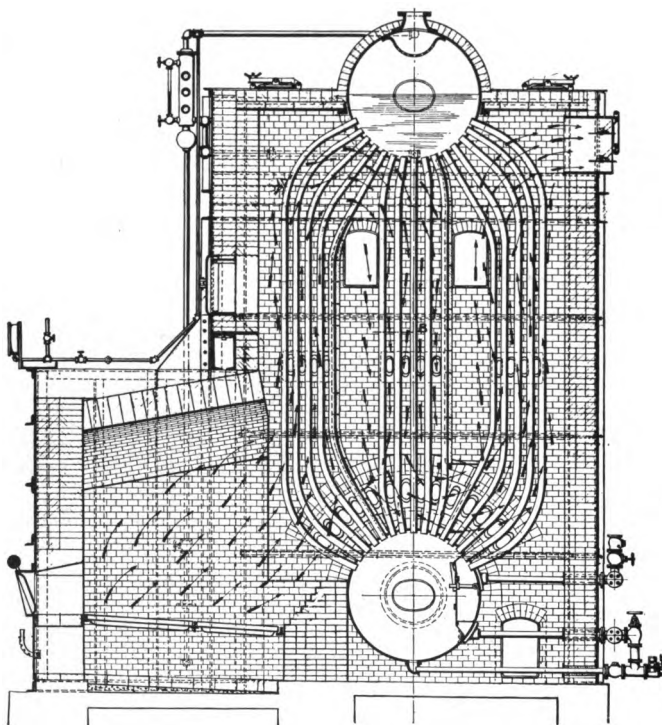
1620 FARMERS BANK BUILDING

PITTSBURGH, PA.

MANUFACTURERS OF THE MILNE WATER TUBE BOILER

MILNE
WATER TUBE BOILER

PATENTED—OTHERS PENDING



Sectional Side View

AIR COOLED FRONT WALL SUPPORT

UNRESTRICTED
CIRCULATION

NO STAYED SURFACES
OR CAST METAL

ELIMINATION OF
SCALE TROUBLES

ALL WROUGHT
STEEL CONSTRUCTION

LARGE OVERLOAD
CAPACITY

LOW STACK
TEMPERATURES

THE GEORGE T. LADD CO.

MILNE WATER TUBE BOILER (Cont'd.)

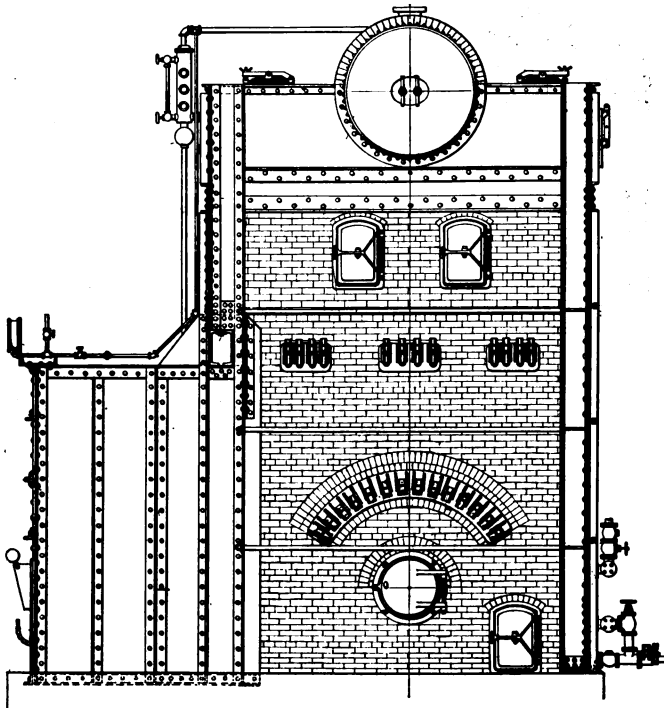
MAXIMUM LIFE
OF SETTING

DRY STEAM

NO HANDHOLE
PLATES

ELIMINATION OF
AIR LEAKS

ALL SUPPORTING MEMBERS OUTSIDE OF BRICKWORK
SIMPLE AND FLEXIBLE



Side View of Setting

HIGHEST EFFICIENCY

ALL TUBES BENT TO SAME RADIUS

EACH TUBE EASILY REMOVEABLE

STAGGERED TUBES

SIZES RANGING FROM 125 TO 1500 H.P. IN TYPE AS ILLUSTRATED
AND TO 2500 H.P. IN MULTI-DRUM TYPE

Write for List of Prominent Users.

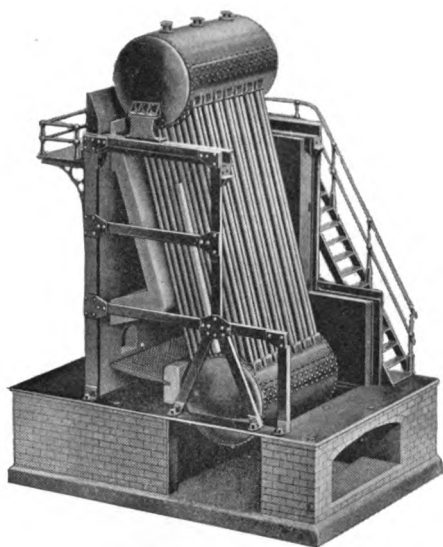
See Bulletin No. 16

JOHN MOHR & SONS

349-359 W. ILLINOIS ST.

CHICAGO, ILL.

MANUFACTURERS OF THE GARBE WATER TUBE BOILER, BLAST FURNACES, STEEL LADLES, HOT STOVES, CUPOLAS, FURNACES, MIXERS, CONVERTERS, STERILIZERS, ETC.



Garbe Patent Water Tube Boiler

THE GARBE BOILER

Special Advantages

All handholes with their troublesome and expensive gaskets are eliminated, as the tubes are expanded into very large drums which are equipped with the patented pressed "Garbe" Plate. Any tube can easily and quickly be inserted, removed and replaced without disturbing any of the others.

Elimination of all flat surfaces, stay bolts and braces. All parts of Boiler are cylindrical and curved.

All tubes are absolutely straight and nearly vertical, therefore the entire circumference of tube is directly exposed to the gases. The effective heating surface is materially larger than that obtained by horizontal tubes.

The upper drum is suspended from a substantial structural frame work, absolutely independent from the mason work. The lower drum is in contact with two slides or guides, thereby allowing free expansion of tubes, equalizing the strain between drums and reducing chances of leakage to a minimum.

The vertical arrangement of tubes allows the steam to develop very freely and to flow by the shortest way possible without changing direction to the upper drum, thereby causing a very rapid circulation. The tubes are distributed over the full length of the Boiler, thus giving a large and uniform steam liberating surface, equal to the full area of the tubes. This vertical arrangement of tubes will do away with local overheating and consequent rupture of the tubes so often occurring in horizontally arranged tubes.

Soot, dust and ashes cannot accumulate on tubes or any part of drum, thereby allowing longer periods of operation without the necessity of cleaning.

Large water capacity, due to the extremely large size of upper and lower drum, insuring a more constant water level than any other Boiler.

The feed water passes through the rear bank of tubes, which have the lowest temperature, to the lower drum and deposits therein all impurities.

Over half of the entire heating surface is effective in liberating steam.

Practically no scale in tubes owing to rapid circulation and vertical tubes.

SPRINGFIELD BOILER & MFG. CO.

SPRINGFIELD, ILL.

BUILDERS OF "SPRINGFIELD" BOILERS

"SPRINGFIELD" WATER TUBE BOILERS

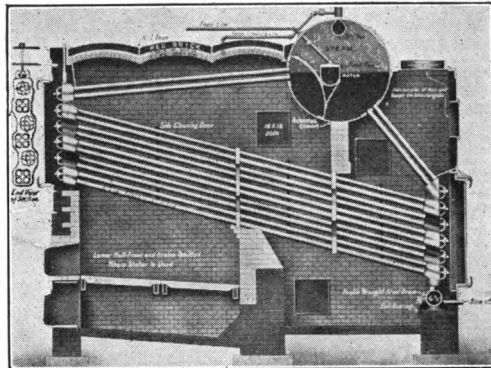
Sectional-Sinuuous Headers

NO Staybolts

NO Braces

NO Bent Tubes

ALL STEEL Construction



Side Elevation

Illustration shows a complete section of the boiler in place, with the front header suspended and the rear resting on a ball bearing. This construction allows the header to come and go from any direction, relieves it from all strain, and does away with the wear and tear that is sure to follow in a boiler where the joints are rigid. The front headers hang from suspension rods. There are no riveted seams where the header is connected to the drum, as in water-leg boilers.

The 3-inch tubes are placed at an angle of 15 degrees. This gives rapid and perfect circulation. They are in groups of four, with one *hand-hole* to each group. Two-thirds less hand-holes than in any other horizontal water-tube boilers; this greatly facilitates and lessens cost of cleaning. Hand holes have *inside plates of drop forged steel*.

Each section is connected to the steam and water drum by four tubes; this gives very large liberating area, evenly distributed over the entire length of the drum. This insures perfect circulation. Drum of large diameter and special dry pipe insures dry steam.

Baffles are made of cast iron, with open face and cast iron sleeves, through which the tubes pass. They are filled with fire clay and cement, held in place by flame bars, and form a solid wall. They are indestructible. Permit removal of any tube without disturbing other tubes or baffles.

Tubes are staggered in such a way as to allow the gases to completely surround them. This allows a thorough mixture of the gases of combustion.

Boiler is very compact; occupies less space than any other boiler of like capacity and requires less brick for its setting; approximately 97 percent of the total heating surface is *in the tubes*.

"SPRINGFIELD" INTERNALLY-FIRED BOILERS

with Corrugated Furnaces, have many valuable features to recommend them both to the Engineer and to the user. They are rapidly becoming adopted everywhere for both power and heating purposes. *Economical* in the use of fuel, floor space occupied, head-room, repairs, and because they are easy to clean.



Write for pamphlets and further data.



TRADE MARK

HENRY VOGT MACHINE CO.

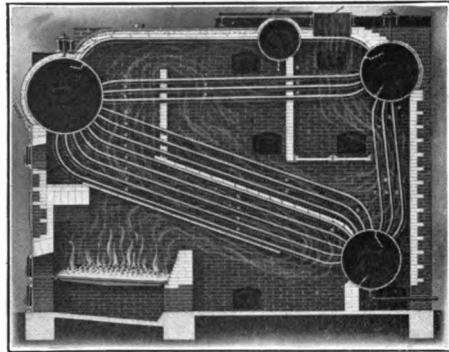
LOUISVILLE, KY., U. S. A.

MANUFACTURERS OF ICE AND REFRIGERATING MACHINES, WATER TUBE AND OTHER BOILERS. DROP FORGINGS

VOGT WATER TUBE BOILERS

The Vogt Water Tube Boiler is constructed to meet the demand for a strictly safe, durable and efficient steam generator, and is free from many objectionable features commonly found in other types of boilers. Look at the cut for the obvious advantages of Vogt Construction:

- Wrought-steel throughout.
- No flat stayed surfaces.
- Accessibility for cleaning and inspection.
- No multitude of hand-hole plates.
- Rapid circulation.
- Complete combustion.
- Dry steam.
- Steadiness of water level.
- Flexibility of construction.



Section Showing Advantages of Vogt Water Tube Boiler Construction

VOGT RETURN TUBULAR BOILERS

The Vogt Return Tubular Boiler is of unusually strong construction, being made of the very best quality of flange or firebox steel, for insuring long wear and withstanding high pressure. The tubes are either lap welded or seamless steel. The larger sizes have longitudinal seams, triple or quadruple riveted double butt strap joints. All flat surfaces are properly stayed with solid steel stays.

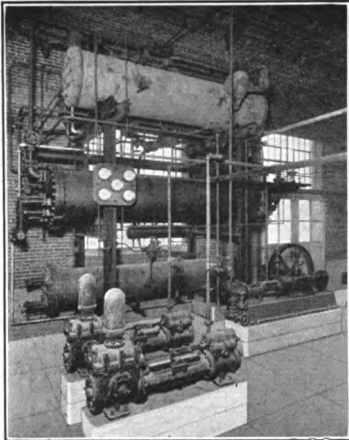
VOGT ICE AND REFRIGERATING MACHINES

Absorption System

The simple construction of the Vogt Refrigerating Machine is one of its many superior features.

It usually consists of an aqua ammonia pump, either of the single, direct-acting or fly-wheel type. An absorber, either horizontal or vertical tubular, atmospheric or double-pipe type. Generator, one or more horizontal cylinders. Exchanger, either tubular or double-pipe type. Rectifier, either tubular or double-pipe type. Weak liquid cooler, either tubular (atmospheric) or double-pipe type.

Illustration shows Horizontal Tubular Absorber and Condenser at top; Generator and Exchanger in center; Brine Cooler and Pumps on floor. Note small space required by the Vogt horizontal construction, permitting the placing of one part above the other.



Installation Louisville City Hospital

Only one running part, the ammonia pump, makes the Vogt Absorption Machine the most simple, economical and durable. Capacities up to 300 tons refrigeration.

THE WICKES BOILER COMPANY

MAIN OFFICE AND WORKS, SAGINAW, MICH.

Sales Offices in Principal Cities

MANUFACTURERS OF STEAM BOILERS

WICKES VERTICAL WATER TUBE BOILERS AND STEEL CASED BOILER SETTINGS

Water Tube Boilers have proved their efficiency. The need is for very simple water tube boilers. The Wickes Vertical Water Tube Boiler has proven its superiority. **FIRST:** It is constructed entirely of homogeneous material and uses straight tubes. **SECOND:** It operates with high commercial efficiency—the sum of all efficiencies.

Two 12x16-inch manholes open in this boiler—one top—one bottom, inspection and cleaning is a simplified matter. Every tube can be looked through, washed or scraped.

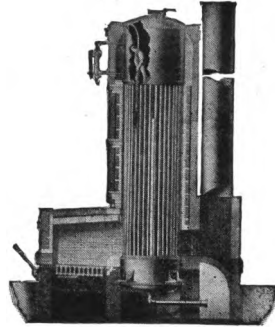
It is easy to clean. If you have ever cleaned a boiler and lamed your back, bruised your knees, and skinned your elbows, you will appreciate the accessible construction of this boiler. Two men can open, turbine and close the Wickes Vertical Water Tube Boiler in ten hours. You know how long it takes to clean some boilers. A clean boiler promotes efficiency. A boiler easy and quick to clean is likely to be cleaned often and well—that is human nature. When your boilers—any of them—stand idle there is a considerable investment upon which you must charge interest that is not earning money—that is not contributing its share to the profit of your Company. On the contrary it is a drag. The overhead and the unit cost of power is low when using this boiler, for it can always be in service.

High furnace temperature results from Dutch oven. Gases entirely surround and closely scrub heating surface from entrance to release. The gases cannot leave the heating surface. There is no possible chance for short-circuiting. The boiler heating surface absorbs the heat—empty pockets in setting lose heat. There are no empty pockets in this boiler. The steel cased settings are always tight, no cracked, warped, leaky, defective and unsightly settings exist with this type. A steel cased setting is a simple and sure cure for air infiltration losses. The largest preventable losses we have to contend with in boiler efficiency are excess air losses. A very long gas travel—hence long contact with heating surface is provided. Heat absorption is, therefore, assured.

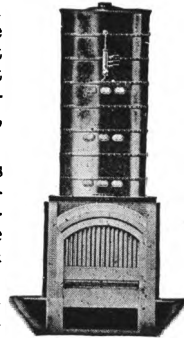
Did you ever wreck an engine by pulling water over into it from boiler? Study this boiler. The steam drum gives great height from water line to steam outlet nozzle. This height provides room for separation of the steam from the water which is entrained with it at a point close to the surface of liberation. Since the shell is subject to a mild degree of heat some superheat is effected on the steam leaving this boiler. You do not pull water over from this boiler.

The concentration of the greatest amount of power per square foot of floor space yet achieved can be attained using this boiler.

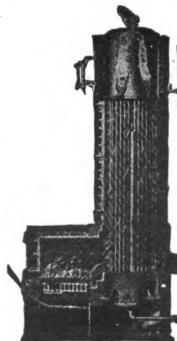
Are you interested in producing boiler horse-power hours per annum cheaply? If so, ask us for particulars.



Cut Shows Position of Man Cleaning. He stands Erect. Is it Laborious Compared with Usual Forms?



Steel Cased Setting



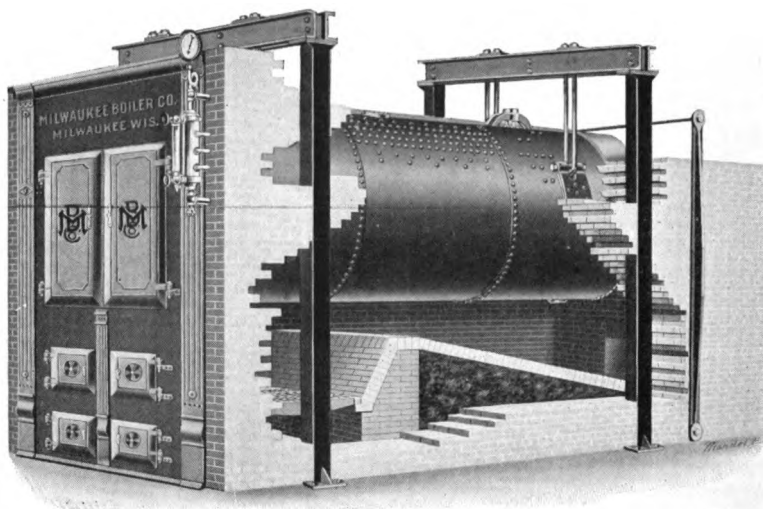
Quick Steaming, Delivering Dry Steam

MILWAUKEE BOILER COMPANY

220 OREGON ST., MILWAUKEE, WIS.

BOILERS, STACKS, TANKS AND STEEL PLATE WORK

MILWAUKEE BOILERS



42

Milwaukee high pressure horizontal tubular boiler with full front and suspension setting

We manufacture power boilers designed for working pressures of 100, 125 and 150 pounds. Every detail of construction has been carefully considered and every precaution taken to secure efficiency, safety and durability.

Both during construction and after completion, rigid inspection and test assure that the highest standards are maintained.

STEEL PLATE CONSTRUCTION

We are Prepared to Furnish anything in Steel Plate Construction for Beet Sugar Refineries, Paper Mills, Oil Refineries, Soap Factories, Wood Alcohol and Turpentine Plants, Tanks (for storage or pressure) with Riveted Seams, Penstocks, Riveted Pipe for Hydraulic and Steam Pressure, Exhaust Pipes, Steam Headers, Exhaust Heaters, Brick Hardening Cylinders, Galvanizing Pots, Retorts, Stills, Agitators, Steam Pans and Jacket Kettles.

Our engineering and estimating department is at your disposal to assist you in designing any article required in our line.

We are prepared to quote favorable prices on Rendering Tanks, Self Supporting Stacks, Riveted Pipe, Gas Purifiers, Water Jackets, Coal Hoppers, and other articles of similar construction.

We carry a large stock consisting of plates, sheets, tubes, rivets, bars and flanges. This enables us to make prompt shipment of all orders.

This stock includes castings of all kinds for boiler setting, also a full supply of valves and gauges.

PHOENIX IRON WORKS CO.

Established 1865

Incorporated 1889

MAIN OFFICE AND WORKS, MEADVILLE, PA.

**MANUFACTURERS OF BOILERS, GENERAL STEEL PLATE, TANKS,
WATER JACKETS, RIVETED PIPE, ETC.**

We Build Anything In

STEEL PLATE CONSTRUCTION

With Either Welded or Riveted Seams

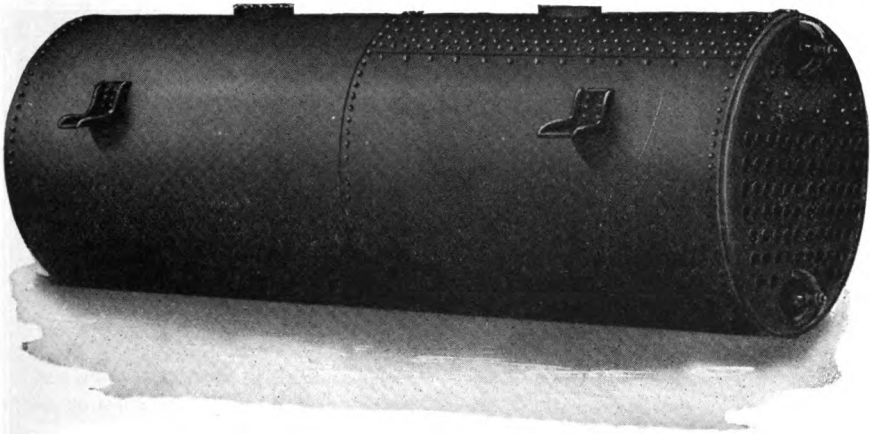
Steel Tanks for any purpose. Stacks, Boilers, etc.

Steel Plate Work of every description.

We carry a diversified stock of Steel Plates, Angles, Bars, Boiler Tubes, Bolts and Rivets.

Machine Flanging

Oxy-Acetylene Welding



GRAY IRON AND SEMI-STEEL CASTINGS

Of the highest quality and guaranteed analysis.

HIGH SPEED AUTOMATIC ENGINES

Simple, Compound and Cross Compound.

Send us your inquiries.

STRUTHERS-WELLS COMPANY

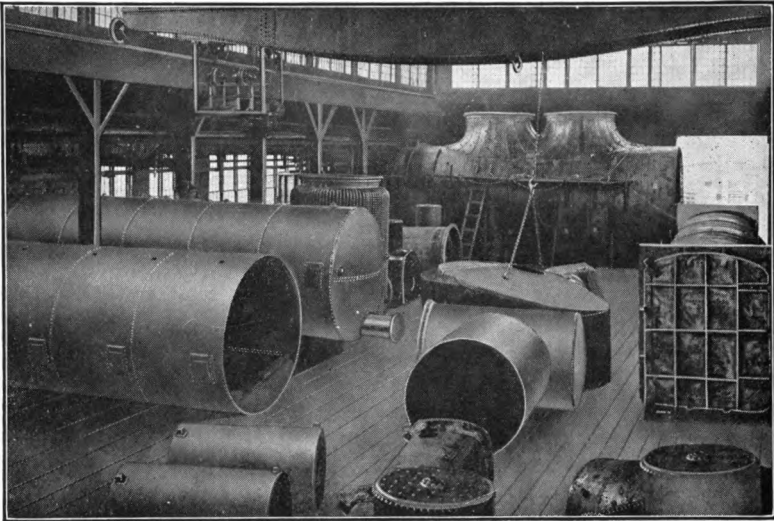
Established 1851

WARREN, PENNSYLVANIA

NEW YORK OFFICE, 50 Church Street

RIVETED AND WELDED STEEL PLATE CONSTRUCTION

Anything in Steel Plate Construction for Beet Sugar Refineries, Paper Mills, Oil Refineries, Soap Factories, Wood Alcohol and Turpentine Plants, Tanks (for Storage or Pressure) with either Welded or Riveted Seams, Penstocks, Riveted Pipe for Hydraulic and Steam Pressure, Exhaust Pipes, Steam Headers, Exhaust Heaters, Brick Hardening Cylinders, Galvanizing Pots, Retorts, Stills, Agitators, Steam Pans, and Jacketed Kettles.



View of one corner of Erecting Floor

We will contract to furnish specially designed work in steel plate from customers' plans and specifications, either completely built up in the shop or assembled, knocked down and shipped in sections as may be called for.

Our equipment and experience enable us to handle both intricate and simple work with equal ease and dispatch. Our workmanship will pass the most rigid inspection

We maintain a fully equipped estimating department at our shops and also at our New York Office. This enables us to furnish prices promptly.

If you want a specially designed piece of work, send us your drawings and specifications,—we have probably built it before, or at least something very similar to it.

Smoke breechings, stacks and air flues for modern buildings are right in our line.

GLASGOW IRON COMPANY

POTTSTOWN, PENNA.

PHILADELPHIA
603 Harrison Bldg.
15th & Market Sts.

NEW YORK
D. F. COONEY & Co.
88 Washington St.

BOSTON
HARRINGTON, ROBINSON & Co.
Sargent Bldg.

MANUFACTURERS OF ALL GRADES OF IRON AND STEEL PLATES

FLANGED and DISHED BOILER HEADS.

Flanged Manholes—Handholes and Flueholes.

ROE STAMPED STEEL MANHEAD and YOKE.

Standard and Heavy Threaded Pipe Flanges.

Companion Flanges—Off Center Pipe Flanges.

MANHOLE SADDLES.

BUCKLED PLATES.

ROE BOILER LUGS.

Rectangular Flanged Heads.

**WELDING AND CUTTING with the OXY-ACETYLENE
TORCH.**

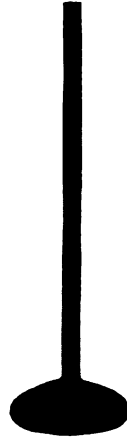
Many shapes formerly made in expensive Bronze Castings can now be made from Steel Plate by Press Work in combination with AUTOGENOUS WELDING.

Pressed Steel HOT BLAST VALVES and VALVE SEATS, Patented.

BOSH COOLING PLATES—TUYERE COOLERS.

FORMING, CUTTING OUT, PUNCHING and BENDING Plate to order.

Bending and Forming ANGLES and SHAPES.



45

The GLASGOW FLAT FLANGES for Rivetted Pipe.

Pressed from Steel Plate—For Any Service.



Made PLAIN or
BORED, FACED,
HUB BEVELLED,
DRILLED, to order.
Any thickness of plate
6 ins. to 72 ins. INSIDE
DIAMETER.

These FLANGES made with a wide flange. Make an excellent expansion Joint for Pipe Lines.

Correspondence Solicited.

LUKENS IRON & STEEL COMPANY

COATESVILLE, PA.

PHILADELPHIA
Commercial Trust Bldg.

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Whitehall Bldg.

BOSTON
Board of Trade Bldg.

BALTIMORE
Continental Trust Bldg.

NEW ORLEANS
634 South Peters St.

CLEVELAND
Rockefeller Bldg.

CHICAGO
1300 N. Branch St.

LOS ANGELES
Citizens Nat. Bank Bldg.

SAN FRANCISCO
Monadnock Bldg.

Cable Address: Lukens, Coatesville, Pa.

Codes—A B C—5th Edition, Western Union

LUKENS

FIRST TO MAKE BOILER PLATES IN AMERICA

One Hundred Years' Experience

The Leader for Boilers and Fireboxes of all Types.

All our plates leveled by special straightening rolls.

STEEL PLATES

Siemens-Martin O. H., Basic or Acid Steel.

Tank, Boiler, Ordinary Firebox, Locomotive Firebox and Special Specification Steel.

UNIVERSAL PLATES

8" wide up to 48" wide, inclusive, $\frac{1}{4}$ " thick and heavier.

FLANGING

Machine-Flanged Boiler Heads, Flanged and Dished Boiled Heads, Flue Holes of any diameter.

We can furnish irregular flanged heads or would be glad to quote on any special flanging as we are especially equipped to take care of same.

"BEST YET" MANHOLE FITTINGS

Our New Patented Manhole Cover Plate has no through riveted bolts. Meets all requirements of Steamboat Inspection Rules.

HUSTON PATENT BOILER BRACE

Superior in quality, strength, lightness in weight, workmanship, general appearance and finish.

Send us your inquiries, stating just what you want, and get immediate replies.

MONONGAHELA TUBE CO.

PITTSBURGH, PA.

**MANUFACTURERS OF IRON AND STEEL BOILER TUBES, OIL WELL
TUBING AND CASING, LINE PIPE, ETC.**

Knobbed Charcoal Iron Boilers Tubes

Soft Steel Boiler Tubes

Genuine Wrought Iron Line Pipe,

Oil Well Tubing and Casing

Also

Sole Manufacturers of

"Armco" (American Ingot) Iron

Boiler Tubes

Lap Weld Pipe

Merchant Casing

47

In "Armco" goods we make all sizes of Boiler Tubes and Pipe 1½" to 8" both inclusive, and Merchant Casing all sizes 2¾" to 8¼" both inclusive.

"Armco" Iron

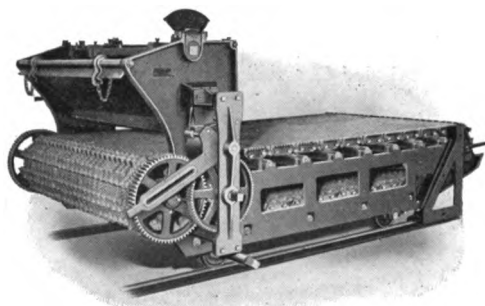
Resists Rust

GREEN ENGINEERING COMPANY

EAST CHICAGO, IND.

MANUFACTURERS OF GREEN CHAIN GRATE STOKERS; GECO RATCHET ASH DRAGS; GECO PRESSURE WATERBACKS; GECO PNEUMATIC ASH HANDLING SYSTEMS; GECO STEAM JET CONVEYORS

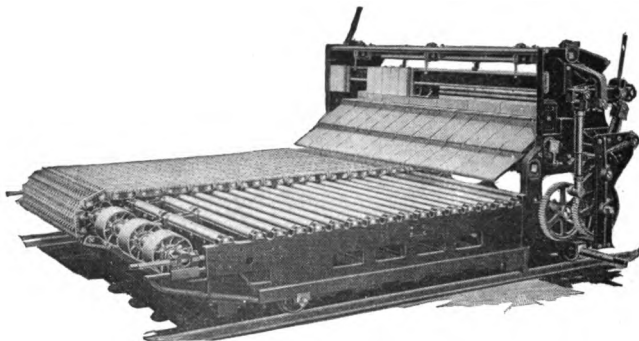
GREEN CHAIN GRATE STOKER



Stoker withdrawn from Setting

The grates are built in any width and in lengths from 9 ft. up to 12 ft. deep. Driving mechanism consists of ratchet, cast-steel pawls and cast-steel spur gear train babbitted in a special self-contained frame independent of, but bolted to the stoker front side frame. Quick adjustment may be had over a wide range and the source of power may be either above or below the boiler-room floor. A regulating feed-gate permits hard firing and is provided with an easily renewable tile lining, which prevents injury to the gate by fire eating back into coal hopper. The igniting arch is adaptable to any width furnace and easily renewable at low cost. It is flat, ventilated, and it gives uniform ignition the full width of the furnace and allows local repairs at any point without undue loss of use of the boiler.

"L"-TYPE GREEN CHAIN GRATE STOKERS

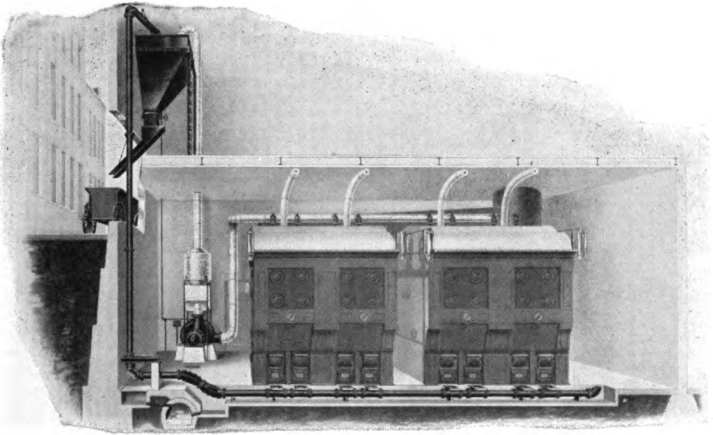


The advantages of automatic operation of chain grate stokers have been enviously hoped for by users of low volatile coal for many years, as no other type of stoker can be operated as cheaply or with such uniformly continuous high economy and high capacity.

"L"-Type Green Chain Grate Stokers provide facilities for treating low volatile coals when introduced into the furnace to force their proper ignition and prepare them for complete combustion thereafter. The facilities provided are all automatic, simple, effective, and through wide range, making the apparatus flexible.

GREEN ENGINEERING COMPANY

GECO PNEUMATIC ASH HANDLING SYSTEM



This system consists of a conveyor pipe located convenient to ash pits and provided with openings into which ashes are readily hoed. Ashes are automatically sprayed, thoroughly quenched, separated from air and deposited. The air current is produced by an exhauster. Tank may be readily emptied by gravity into wagons or cars.

Dust and obnoxious gases are eliminated. Safety to operatives and property is assured. One man operates the entire system. Operation depends on an engine or motor with exhauster, the only moving machinery, both operating in clean surroundings, always subject to complete inspection and therefore readily given necessary attention and easily maintained.

Maintenance cost is low. Parts subject to wear can be easily replaced.

Separator tank and dust collector prevent ashes or dust entering exhauster and causing unusual wear.

GECO STEAM JET ASH CONVEYOR

For small plants a Steam Jet System is recommended. Ashes are disposed of instantly without dust or gases. The air current is produced by Steam Jets which are placed in the elbows of the conveyor pipe. The system is operated by turning a steam valve and is simple and reliable. The tank can be made of wood, concrete or steel. These systems may be adapted to any building construction or arrangement and ash storage tanks may be placed at location most accessible for wagon or cars.

GECO metal used in this conveyor is extremely hard and wear resisting.

The maintenance cost is low and parts which are worn can be easily replaced.

Write for bulletins.



MURPHY IRON WORKS

FOUNDED 1878

DETROIT, MICHIGAN

MANUFACTURERS OF THE MURPHY AUTOMATIC SMOKELESS FURNACE

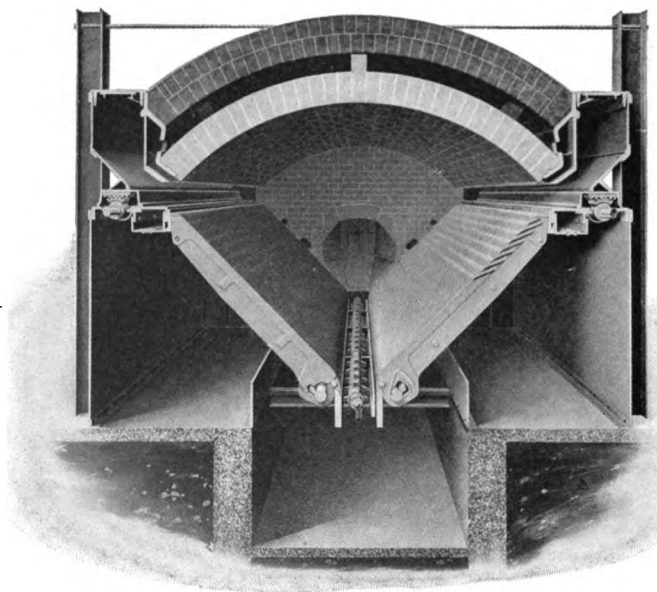
THE MURPHY AUTOMATIC FURNACE is automatic in all its functions. It feeds and distributes the coal and removes the ash and refuse.

It is adaptable to any type of boiler and to units of any size.

It will handle economically all grades of bituminous fuels and is practically smokeless under normal operating conditions.

It is capable of handling variable loads and heavy overloads efficiently and with minimum attention.

The cost of maintenance is low, averaging about 10c. per horsepower per year.



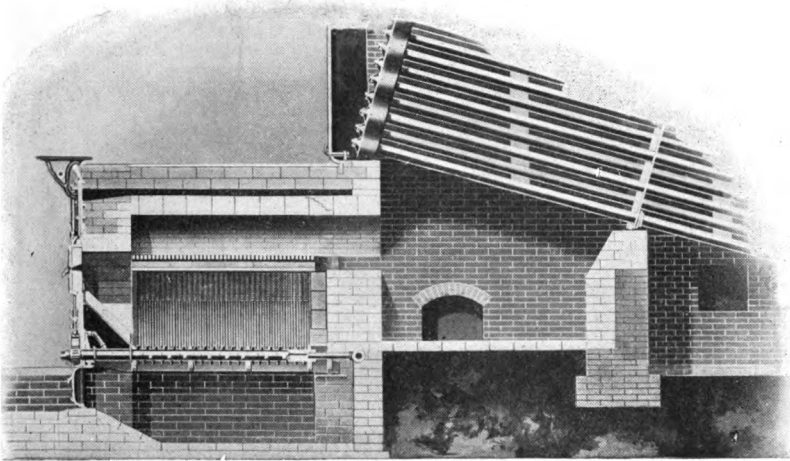
The Murphy Automatic Smokeless Furnace
REAR VIEW

The cost of actuation approximates $\frac{3}{4}$ to 1 per cent of total steam generated.

THE MURPHY FURNACE is designed for either NATURAL OR FORCED DRAFT or for combined forced and natural draft. With natural draft the standard sizes of furnaces under proper conditions will operate the boilers up to approximately 200% of their rated capacity—with forced draft to 300% of rating and over.

THE MURPHY HEAVY DUTY FURNACE, for combined natural and forced draft, is an ideal equipment for central stations and plants having heavy overloads and severe peaks. This furnace combines high efficiency and low cost of actuation—obtainable under natural draft conditions—and provides for sudden demands for steam and heavy overloads quickly and efficiently.

MURPHY IRON WORKS



Murphy Furnace—Dutch Oven Setting

At either side of the furnace extending from front to rear is the coal magazine into which the coal may be introduced either by hand or mechanically. At the bottom of this magazine is the coking plate against which the inclined grates rest at their upper ends. The stoker boxes, operated by segment gear shafts and racks, push the coal over the coking plate and on to the grates. The grates are made in pairs, one fixed and the other movable. The stationary grates at their lower ends, rest on the grate bearer, which also acts as a support for the clinker grinder. The clinker grinder consists of a square steel shaft, on to which is slipped small cast iron toothed segments, which are readily replaced in case of breakage.

Just over the coking plate is the arch plate, from which a fire brick arch is sprung over the entire furnace. Upon this arch plate are cast numerous ribs to form a series of air ducts immediately over the coking plate, conveying the heated air from the chamber above the arch into the combustion chamber. This arch plate also forms the wall of the magazine. The furnace, or battery of furnaces, can be operated by a small automatic engine, motor or by overhead shaft and ratchet drive, as may be desired. Arrangement is made for exhaust steam connections at the lower end of the grates for the protection of this portion of the grates and clinker grinders and for the softening of the clinker. In connection with horizontal tubular boilers or water tube boilers horizontally baffled, the Murphy furnace can be installed with a flush front setting. Arrangement can be made for extended or Dutch oven settings, should this be desired.



ROSEDALE FOUNDRY & MACHINE CO.

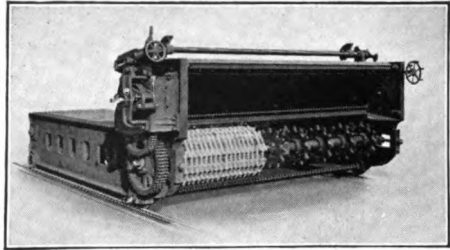
ESTABLISHED 1871

PITTSBURGH, PA.

ENGINEERS, FOUNDERS & MACHINISTS

PLAYFORD TYPE B CHAIN GRATE STOKER

The PLAYFORD TYPE B STOKER has been designed to fulfill the requirements for a chain grate stoker to operate under continuous heavy duty and exacting power plant service; no detail of cost in material or workmanship which would in any particular add to the strength, rigidity or durability of a stoker operating continuously under large overloads, has been omitted in its construction.



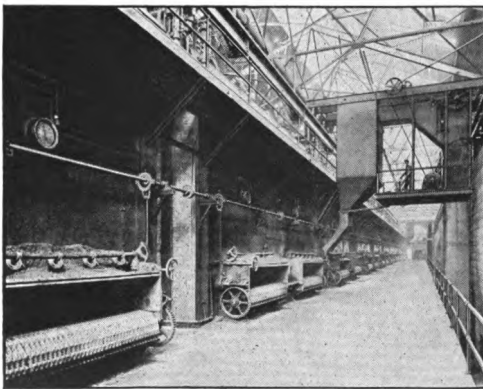
In determining the most desirable type or make of mechanical stoker, the essential points for consideration, in varying relative importance for different conditions are as follows:—

1. Continuous operation with minimum loss of time for repairs. 2. Capacity to quickly develop and to continuously maintain large overloads without forced draft apparatus. 3. A high combined efficiency under daily operating conditions, as distinguished from the extreme high efficiencies obtained under ideal test conditions. 4. Minimum amount of labor for operation, requiring the most unskilled type of operatives. 5. Low cost of maintenance, not exceeding five to ten cents per rated H.P. per annum for periods of five to nine years continuous operation. 6. Smokeless combustion using the available bituminous or semi-bituminous coals of lowest cost to the existing plant.

Data in detail as to the fulfillment of these standard requirements by Playford Stokers is available and will be submitted upon request.

IMPORTANT FEATURES OF THE TYPE B PLAYFORD STOKER

1. Positive spur gear drive, gears covered and protected.
2. Gears may be removed and reversed when teeth are worn, placing opposite face of teeth in contact, thus obtaining double service.
3. Grate bar links can be replaced without removal of the supporting rods.
4. Adjustment of chain tension at front and rear, permitting adjustment at any time while stoker is in operation.
5. Lubrication of front and rear main shaft bearings.
6. Safety automatic release of drive preventing damage of machine through an accidental breaking of any part.
7. Patented water cooled fuel gate, preventing back firing in coal hopper.
8. Stoker designed to permit entire rebuilding without removal from the furnace.
9. Heavy center structural steel supports and braces for stokers over 8' in width, also heavy steel I beam transverse bracing.
10. Ventilated ignition arch of special fire brick shapes easily replaced and of the highest quality of refractory material obtainable.
11. Either fixed high or low pressure or movable water cooled back at bridge wall, the latter preventing all leakage of air over fire at this point, as well as permitting the dumping of large clinker into the ash pit.



24-400 H.P. Boilers, 9600 H.P. Equipped with Playford Stokers; Operated by Three Firemen, One Water Tender, and One Boy on Coal Conveyor.

Descriptive literature, drawings showing the application of Playford Stokers to any standard type of water tube boiler, and other data will be forwarded upon request.

QUIGLEY FURNACE & FOUNDRY CO.

GENERAL SALES AND ENGINEERING OFFICES

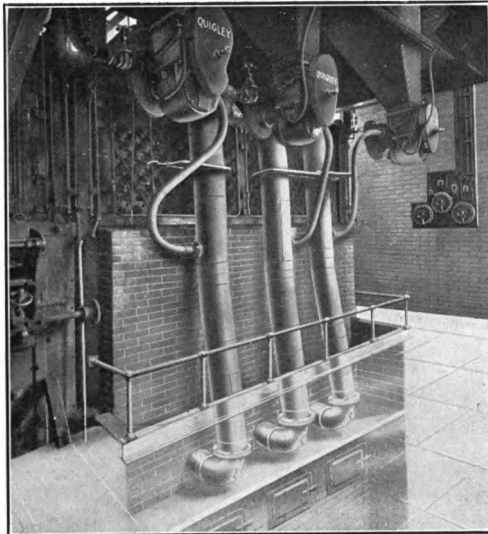
105 W. 40TH ST., NEW YORK

WORKS: SPRINGFIELD, MASS.

Canadian Agents: The W. W. Butler Co., Ltd., Montreal

**ENGINEERS AND CONTRACTORS: BUILDERS OF POWDERED COAL,
OIL AND GAS BURNING FURNACE EQUIPMENT**

After Two Years' Work We have Successfully Solved the Problem of
FIRING BOILERS WITH POWDERED COAL
and will now contract to install the complete equipment for preparing and burning
Powdered Coal, and guarantee proper operation.



Powdered Coal Applied to a 300-H.P. Franklin Water-tube Boiler, Showing Rheostats for Regulating Coal Supply, Electrically Driven Powdered Coal Controllers, Coal Bins and Blast Pipes.

FOUR MONTHS' COMPARATIVE TESTS ON THE ABOVE 300-H.P. FRANKLIN WATER TUBE BOILER

Mechanical Stoker vs. Powdered Coal	Stoker	Powdered Coal	Gain Powdered Coal
*Evaporation per pound coal as fired	6.96 lb.	9.02 lb.	29.6%
Efficiency of boiler	58.86%	73.1%	24.0%
CO ₂ in Flue Gases	10.07%	14.6%	45%
Coal per boiler h.p. per hour	4.82 lb.	3.43 lb.	28.8%

* Slack Coal used, averaging 12,570 B.t.u. per lb., ash 16.84%.

Stoking and fuel handling eliminated.

Maintenance of boiler and brick work materially reduced.

Ash removal is accomplished by one laborer in two hours every second week.

The rate of combustion is controlled by operating a valve.
The boiler is under almost instant control and responds promptly to change in load.

POSITIVELY NO SMOKE.



GWYNN GAS BURNER & ENGRG. CO.

713-714 EMPIRE BLDG., PITTSBURGH, PA.

GAS BURNING EQUIPMENT FURNISHED PROMPTLY FOR ANY KIND OF SERVICE WHERE NATURAL GAS IS USED FOR FUEL

FUEL EFFICIENCY

This means **HEAT**—which is our business to supply. If it is a question of **NATURAL GAS**, advise us as to what purpose you wish to apply the same, and we will submit plans and proposition free of charge.

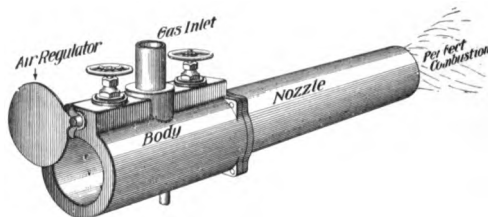


Fig. 1

Fig. 1 shows our Open Ended Type of Burner, used for all **HIGH PRESSURE BOILERS, LARGE HEATING BOILERS,** and other work where **HIGH POWER BURNERS** are required, (with either a high or low temperature).

Ask for Catalogue No. 10.

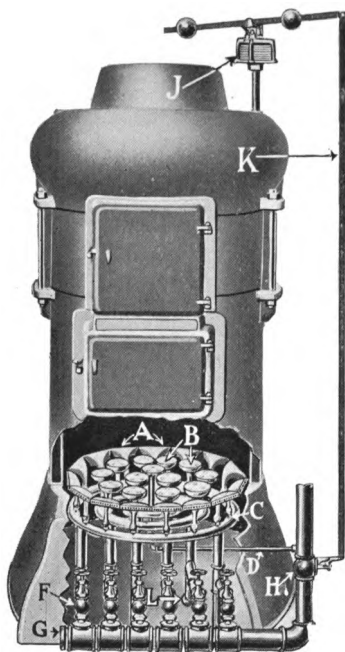


Fig. 2

Fig. 2 shows our Standard type of Burner, which is used for all **DOMESTIC WORK**, either with **STEAM, HOT WATER,** or **HOT AIR** Furnaces having a round fire pot, and are **GUARANTEED** to reduce gas bills.

Ask for Catalogue No. 15.

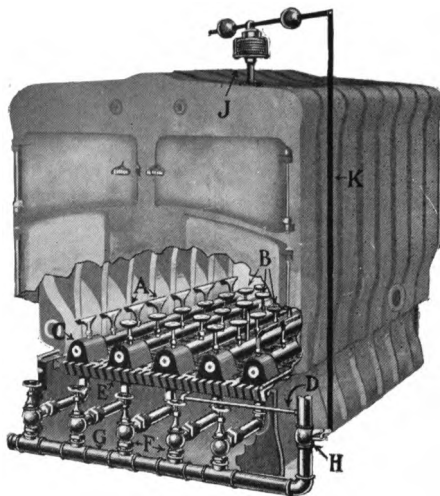


Fig. 3

Fig. 3 shows our Standard type of Burner for Furnaces having a square or rectangular fire box, either **HOT AIR, HOT WATER** or **STEAM**, and can be used with the best results for **DOMESTIC WORK** or any place where boilers or furnaces of this type are required.

Ask for Catalogue No. 15.

McCLAVE-BROOKS COMPANY

MAIN OFFICE AND WORKS, SCRANTON, PA.

NEW YORK OFFICE
50 Church St.

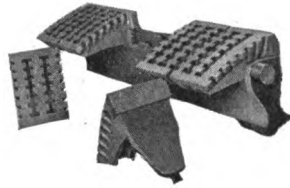
CHICAGO OFFICE
708 Fisher Bldg.

MANUFACTURERS OF McCLAVE'S STOKER, McCLAVE'S SHAKING, CUT-OFF AND DUMPING GRATES, McCLAVE'S ARGAND STEAM BLOWER. ALL KINDS OF IRON AND BRASS CASTINGS

McCLAVE'S SHAKING, CUT-OFF AND DUMPING GRATES

Made in four different types: Nos. 1 and 2 being used principally for soft coal and the larger sizes of anthracite: Nos. 3 and 4-A for the smaller anthracite sizes.

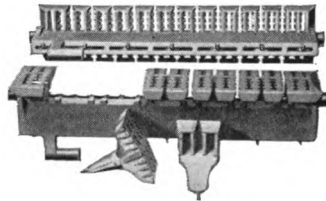
McClave Grate No. 1 is our old type of Shaking and Cut-off Grate, in which all of the grate bars are cast integral. In our new type, **No. 2**, the regular grate bars are made with *Removable Sectional Tops*, with shanks which are mounted in sockets in the pendant body portion of the bars. Cost of repairs is thus reduced to a minimum. These grates have an absolute cut-off movement, in which each row or section can be operated as a whole, or the front and rear separately. In the shaking movement there is no increase in the openings between bars, consequently no waste of unconsumed fuel.



McClave Grate No. 2

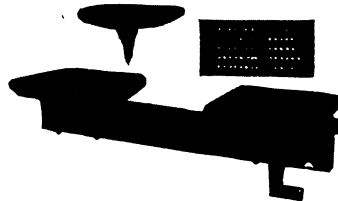
McClave Grate No. 3. Specially adapted to burn the smaller sizes of Anthracite fuel, such as Buckwheat, Birdseye, Rice, etc.

The Grate Bars are constructed with a body portion and *Removable Sectional Tops*, the shanks on the tops being arranged centrally, which makes practically a "T" formation, whereby a double cut-off movement is secured by forming pockets on either side of the bars. Each row can be operated as a whole, or the front and rear separately.



McClave Grate No. 3

McClave Grate No. 4-A. This a dumping grate, specially designed to burn the smaller sizes of Anthracite Coal. Sectional Removable Tops are made with beveled edges at end, to allow for expansion. Overlapping of edges of bars prevents sifting between the bars. Fitted with twin levers for operating the front and rear series of bars separately.



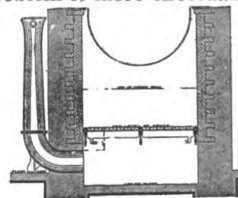
McClave Grate No. 4-A

The mesh or air space in the tops is made as small as $\frac{3}{32}$ " for the very small sizes. The construction as a whole is very strong and durable.

Grate frames are made in one or more rows, as required, with expansion top Journal Bearing Bars reaching from the front to rear of furnace, and having Journal Locks which fit over the journals of the Grate Bars, to prevent the bars from lifting out of their bearings when they are being operated.

McCLAVE'S ARGAND BLOWER

The result of over thirty years' experience with the problem of more effectually burning the cheaper grates of Anthracite and Bituminous fuels. Gives a properly proportioned combined air and steam blast, and forms a complete system when used in connection with McClave Grates. Large volume of air with small steam consumption guaranteed. Practically noiseless in operation, Automatic Blower Regulator also furnished when desired. Illustration shows new type High Duty Blower installed through side wall of boiler.

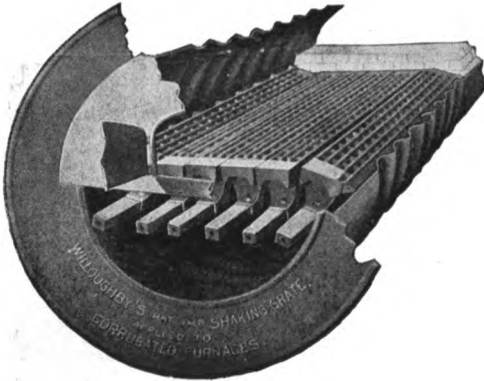


ST. JOHN GRATE BAR COMPANY

MACHINERY DEPT., THE BOURSE, PHILADELPHIA

MANUFACTURERS OF WILLOUGHBY PATENT FURNACE EQUIPMENT.
CONSULTING AND MECHANICAL ENGINEERS, EXPERTS IN COMBUSTION

WILLOUGHBY'S PATENT IMPROVED SHAKING GRATES AND FURNACES



These grates are especially adapted for Internally Fired Corrugated Furnaces, though used to advantage in all kinds of boilers and furnaces, with any fuel, and with natural, forced or induced draft.

Their use does away very largely with the need of "cleaning fires," since the construction and operation is such that all refuse can be broken up and passed through the bars by shaking. These grates have been run seven weeks without cleaning, using Pittsburgh coal in internally fired boilers.

56

CONSTRUCTIONAL FEATURES

These grates run longitudinally, and present a flat surface to fire upon, over which a slice bar or hoe may be used without catching. This is impossible with round or curved top design grates running crosswise.

SUMMARY OF ADVANTAGES

The most business-like grate on the market, absolutely "fool proof."

It is simple in construction. Easily operated.

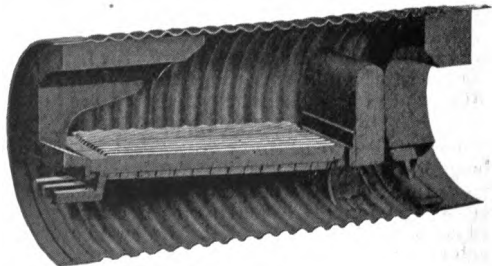
It will reduce your coal bills. Adapted to any style furnace.

Adapted to either hard or soft coal. Will reduce the clinker to a minimum.

Increased air space. Will improve the efficiency of your boiler.

Cleanings are reduced to a minimum, and doors kept closed longer than with any other method.

Guarantee: With the installation of the WILLOUGHBY PATENT IMPROVED SHAKING GRATES, we will guarantee the ability to develop twenty-five per cent higher capacity than can be secured from flat stationary grates under like conditions, or, we will guarantee the ability to develop the same capacity as you now secure (from flat grates) on at least ten per cent less fuel under like conditions on a twenty-four hour (or longer) run. Provided: an evaporation test be made with both flat grates and this grate in the presence of our representative.



Expert advice as to necessary requirements for the most efficient combustion of Bituminous Coal. Stationary Grates of approved design for all Fuels.

MONARCH BOILER ARCH COMPANY

631 WELLS BLDG., MILWAUKEE, WIS.

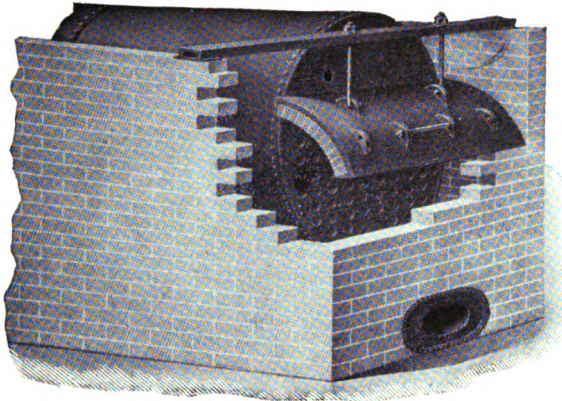
MANUFACTURERS OF REAR COMBUSTION CHAMBER AND FIRE DOOR ARCHES FOR RETURN TUBULAR AND INTERNALLY FIRED BOILERS

MONARCH PATENTED BOILER ARCHES

For Fire Doors and Rear Combustion Chamber Arches of Tubular and Internally Fired Boilers

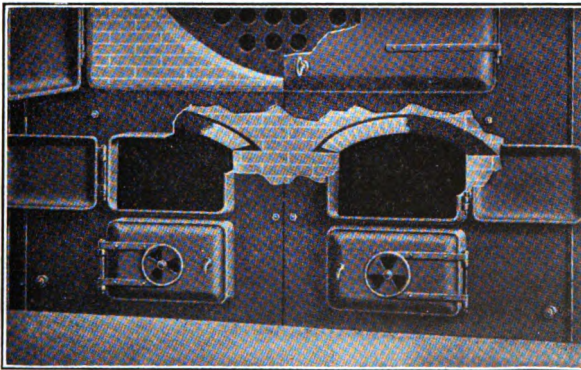
SOLVE THE BOILER SETTING PROBLEM

They are absolutely different from anything on the market, easily installed and guaranteed for five years.



Rear Combustion Chamber Arch

We use only best grade of fire brick and there is no binder between them to burn out. The brick are held in place by the metal which is shrunk around them and consequently they cannot fall out. There is no metal exposed to the heat, and they are absolutely air tight. No more annoying delays and expensive repairs due to faulty arches. They have been used in representative power plants throughout the country for the past ten years.



Fire Door Arch

Full information, list of satisfied users and free booklet entitled "HORIZONTAL TUBULAR BOILER SETTING," sent on request.

H. BLOOMSBURG & CO.

425 N. CARY ST., BALTIMORE, MD.

CIRCULATORS; STEAM JETS FOR STEAM BOILERS

THE EQUILIBRIUM CIRCULATOR AND STEAM HEATING ATTACHMENT

For Heating and Circulating the Water in Steam Boilers

NEARLY 600 APPARATUS INSTALLED

Equalizes the temperature of all parts of the boiler, thus preventing the unequal expansion and contraction, with consequent leaks of seams and rivets, due to such straining.

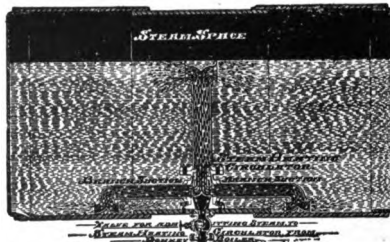
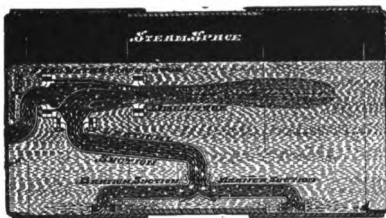
Increases Steaming Capacity 5 to 15 per cent. on same fuel consumption or the same power on a corresponding reduction in fuel.

Saves cost of repairs and prolongs life of boiler.

Prevents the deposit of mud and sediment, and the formation of scale. Prevents or reduces foaming (or priming) and pitting.

By using steam from another boiler, while starting fires, steam may be raised from cold water in an hour, without straining boiler.

We guarantee satisfactory results when properly installed.



Section of Feed Water Circulator and Pipes on Larger Scale than Boiler

The action of the apparatus is as follows: FEED WATER, on being admitted to the boiler, discharges through FEED WATER CIRCULATOR and DISCHARGE NOZZLE as shown by arrows, this causes an induced current of water to flow up the VERTICAL SUCTION pipe and out through DISCHARGE nozzle mixing with the feed water as it discharges into boiler. WATER FROM BOTTOM OF BOILER now enters inlet tees and passing through BRANCH SUCTION PIPES enters the VERTICAL SUCTION PIPE, to supply the current flowing up it as shown by arrows. This action removes all the colder water from bottom of boiler and discharges it at the surface after it has become heated in its passage through the VERTICAL SUCTION PIPES by the hot water surrounding, then mixing with feed water raises its temperature before it is discharged into boiler. As the cold water is carried to the surface the hot water settles down to replace it, thus creating a rapid movement of the water in all parts of the boiler.

Section of Steam Heating Circulator and Pipes on Larger Scale than Boiler

The operation of this apparatus is as follows when getting up steam from cold water: While starting fires, steam is admitted to STEAM HEATING CIRCULATOR from Donkey boiler (or another boiler). This steam discharges through STEAM HEATING CIRCULATOR, as shown by arrows, up the vertical discharge pipe, heating the water in this pipe to a high temperature and causing an induced current to flow upward and discharge through the distributing tee at the surface. Cold water then enters from bottom of boiler through the inlet tees and passing through BRANCH SUCTION PIPES and STEAM HEATING CIRCULATOR, passes up the vertical discharge pipe, is heated in contact with the steam and discharges at surface as shown by arrows. This action continues until all the cold water in bottom of boiler has been carried to the surface and heated and the hot water has settled down to replace it. Thus all the water becomes heated to an even temperature ready for making steam in about an hour. Steam heating circulator may be combined with feed water circulator.

SPECIFICATIONS

Size of Feed and Suction Pipes	Horse Power of Stationary Boilers at 30 lbs. of Water per H. P.	Price of Feed Water Circulator	Price Steam Heating	Price Total	Size Branch Suction Pipes	Size of Tees on Branch Suction Pipes
1 1/4 inch	55 to 110 H.P.	\$30.00	.....	.....	1 inch	1/2"x1/2"x1"
1 1/2 "	80 " 160 "	40.00	.....	.....	1 1/4 "	3/4"x1/2"x1 1/4"
2 "	140 " 280 "	50.00	\$40.00	\$90.00	1 1/2 "	1"x1"x1 1/2"
2 1/2 "	220 " 440 "	60.00	50.00	110.00	2 "	1 1/4"x1 1/4"x2"
3 "	320 " 640 "	70.00	60.00	130.00	2 1/2 "	1 1/2"x1 1/2"x2 1/2"

The above prices are for the Machines only and do not include Piping, Fittings, or Erection.
Send for Catalogue if interested.

ERIE PUMP AND EQUIPMENT CO.

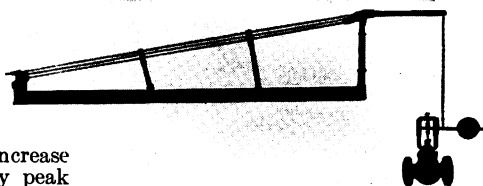
(Succeeding the Northern Equipment Co. and Erie Pump & Engine Works)

MAIN OFFICE AND WORKS: ERIE, PA.

CENTRIFUGAL PUMPS—STEAM SPECIALTIES

COPESES BOILER FEED REGULATORS

In designing the new "Copes" Regulator, known as type BH, we adhered to the modern idea that the water should be fed continuously while the boiler is under load, and that the water level should be automatically lowered to increase the steaming capacity to carry peak and overloads; that during subnormal and no loads the level should be raised to store up heat energy which would otherwise be wasted through the pop valve or up the stack.



Copes Type "BH" Boiler Feed Regulator

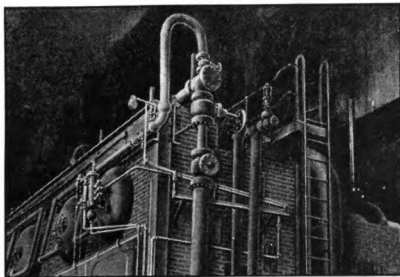
"This method of feed control enables peak loads of short duration to be carried with a more uniform working of the furnace, as sudden demands for steam will cause a fall in the water level without a corresponding increase in the rate of feed."

B. F. Wood, Report of Committee on Power Generation, Am. El. Ry. Eng. Assn.

Copes Regulators have no Floats, Springs, Diaphragms, Pilot Valves, Concealed Parts, or Delicate Mechanism. They can be installed on any boiler and are guaranteed as to operation and maintenance. Control valve can be placed in horizontal, vertical or angle feed line and either above or below the expansion tube. Operation is absolutely reliable and is dependent upon direct expansion and contraction of a straight metal tube six feet long.

Automatic boiler feeding is no longer a luxury but a vital necessity of the modern boiler plant. The Copes Regulator means this to you:

- (1) Higher overload capacity.
- (2) More constant furnace conditions.
- (3) Less drop in pressure at overloads.
- (4) Storage of heat at low loads.
- (5) Even distribution of load between boilers.
- (6) Smooth rate of feed; no spasmodic opening and closing of the feed valve.
- (7) Smaller feed lines and valves.
- (8) More even load on feed pump.
- (9) More legible water meter and steam meter charts.
- (10) Dry steam since the water level cannot exceed a predetermined level and because the level is a minimum for greatest loads.
- (11) Higher superheat because water is not carried over into superheater tubes.
- (12) More constant superheat because the rate of steam delivery is not affected by intermittent feeding.
- (13) Higher temperature of feed water, which is drawn from the heater at a more even rate.

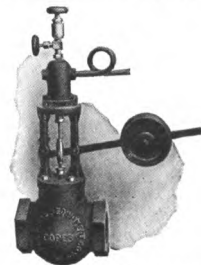


Typical Installation on B. & W. Boiler

COPESES PUMP GOVERNORS

The Copes Pump Governor comprises a balanced valve controlling the steam supply to the pump or turbine driving the pump, a small cylinder and operating piston, a lever, and counter-weight. Made in Flanged, Angle or Straightway type; sizes $1\frac{1}{4}$ " to 8" and Screwed Angle or Straightway type; sizes $\frac{3}{4}$ " to 3".

When used for boiler feed service, the governor is installed to maintain a constant difference between feed line and boiler pressures. Also widely used for maintaining constant pump pressure, as for house tank service, fire pumps, elevator pumps, etc.



Copes Pump Governor

BAYER STEAM SOOT BLOWER CO.

MAIN OFFICE AND WORKS

2828-40 LA SALLE ST., ST. LOUIS, MO.

NEW YORK

PHILADELPHIA

BOSTON

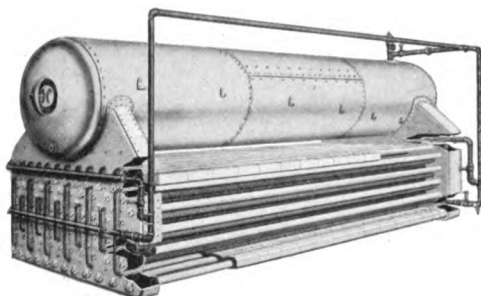
CHICAGO

PITTSBURGH

NEW ORLEANS

MANUFACTURERS OF SOOT BLOWERS FOR ALL TYPES OF STEAM BOILERS

THE BAYER PATENTED SOOT BLOWER SYSTEM



Type "H" as Installed on Heine Type Water Tube Boiler

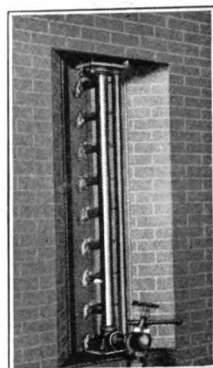
For Horizontally Baffled Boilers

By studying the application of the system as shown on illustration it will be readily seen that our Type "H" Blower can be installed without disturbing a single brick in the setting or altering anything whatever about the boiler. Note how the jets or nozzles enter the hollow staybolts thereby being absolutely

protected from the heat. Each header and section of nozzles can be removed in a few minutes.

For Vertically Baffled Boilers

In bringing our type "B" Blower to its present stage of perfection we realized the importance of producing a device that could be installed without making any alteration in the boiler settings. The illustration shows the simplicity and ease with which the apparatus can be attached to any vertically baffled boiler having side cleaning openings. The units of the Bayer System are secured to the plates at the top and bottom of the openings in the walls permitting the blower to be quickly, accurately and securely adjusted to its proper position even while boilers are in service.



Type "B" as Installed on B & W Type Water Tube Boiler

We manufacture Soot Blowers for all types of steam boilers (water tube and fire tube) and are prepared to furnish detailed drawings, as well as individual literature, fully describing the various types of Bayer Soot Blowers for any particular type of boiler.

Put your soot troubles up to us. Our years of experience are at your service.

DIAMOND POWER SPECIALTY CO.

DETROIT, MICH.

BRANCH OFFICES

NEW YORK
CHICAGO
PHILADELPHIA
BOSTON

Agencies in all large cities

EXPORT FACTORY
WINDSOR, ONT.
CANADA

AGENCIES IN

Principal
Foreign
Cities

SOOT BLOWERS TO SUIT EVERY TYPE OF BOILER

DIAMOND MECHANICAL SOOT BLOWERS

**Gary Plant of U. S. Steel Corp. Installs 26 "Diamonds" after Various Tests
Covering a Period of Nearly Two Years**

Diamond Soot Blowers are recognized as the STANDARD mechanical soot blowing equipment for all types of water tube and fire tube boilers.

Diamond Soot Blowers have been on the market for nearly eighteen years: Today there are nearly 40,000 in use. Among the list of Diamond users are such concerns as: Gary plant of the U. S. Steel Corporation (26 boilers equipped), Inland Steel Company, Quaker Oats Company, Republic Iron & Steel Co., Federal Rubber Company, Anheuser Busch Breweries, Hudson Motor Car Co., Chalmers Motor Car Company, American Tobacco Co., Pittsburg Steamship Company, and thousands of others as large and well known concerns. The U. S. Government uses a large number of Diamond Soot Blowers on marine and stationary boilers. Eleven boilers at the Government Hospital for the Insane have recently been equipped.

What They Will Do: Diamond Soot Blowers are guaranteed to keep the heating surfaces of the boiler on which they are installed free from soot and ash thus allowing these surfaces to absorb the maximum amount of heat from the gases of combustion as they pass through the boiler. This insures a considerable saving in fuel and a marked increase in the general efficiency of the boiler.

Durability: Diamond Soot Blowers are built to last indefinitely, if given the same attention any mechanical device is given.

Each type of Diamond Soot Blower is specially built and installed to successfully withstand the varied temperatures of the gases existing in those parts of the boiler where the equipment is placed.

Operation: Diamond Soot Blowers are easy to operate. The operating mechanism is all on the outside within easy reach. No doors or slides have to be opened. The boiler is kept free from soot accumulation while under full load. With a Diamond Soot Blower installed a fire tube boiler can be cleaned in from three to four minutes and a water tube boiler in from five to eight minutes. The Kellogg Toasted Corn Flakes Company were able to dispense with the services of one man in their boiler plant after installing Diamond Soot Blowers.

A Strong Endorsement: A sales representative of one of the largest and best known boiler manufacturers recently made a statement to the effect that he had lost a sale of a boiler because the prospect had recently installed Diamond Soot Blowers on his boilers and the general efficiency was so increased that another boiler was not necessary.

Catalogue describing the Diamond Soot Blower in detail that will meet the requirements of your boilers will be sent on request.



*There's a Diamond Soot Blower to suit
every type of Boiler.*



TRADE MARK

THE KENNICOTT COMPANY

OFFICE: CORN EXCHANGE BLDG.
CHICAGO

FACTORY AT
CHICAGO HEIGHTS, ILL.

**EQUIPMENT FOR WATER SOFTENING, FILTRATION, MEASUREMENT
AND STORAGE**

**STEEL STACKS, TANK CARS, TANKS AND TOWERS, STEEL UNDER-
FRAMES. GENERAL STEEL PLATE CONSTRUCTION**

KENNICOTT WATER SOFTENER



The Kennicott Water Softener automatically treats varying quantities of water with the correct quantities of material always in proper proportion, requires only a small amount of attention and softens water at lowest cost.

The Kennicott is the only Softener where the parts which regulate the feed of chemicals do not come in contact with the chemicals. Accuracy in feeding is always maintained.

The Kennicott Softener is built in various sizes from 500 gallons of water per hour to 150,000 gallons per hour—the largest continuous steel tank Softener in the world having been built and installed by the KENNICOTT COMPANY.

KENNICOTT-JEWELL FILTERS

The Kennicott-Jewell filter will clear muddy, roily-polluted or infected water. The result of 25 years' experience in filtration. Equipped with our patented airless negative head strainer system permitting direct suction connection if desired. The most turbid water is clarified by our Pressure or Gravity filters. Installed in some of the largest power plants, office buildings and manufacturing industries.

The Kennicott-Jewell filter will give you a clear bright water free from stain and sediment.

KENNICOTT WATER WEIGHERS



Do you know your evaporation?
Do you know how much steam you
make each day?

Do you know how much you pay for
steam?

Do you know which fuel is most
economical?

These questions and many other
important questions are answered AC-
CURATELY by the KENNICOTT
WATER WEIGHER.

This device operates automatically
and continuously. It receives water
from open heater pipe line or any other
source and delivers it in unit charges of
definite weight. A counter conveniently
located registers each unit charge de-
livered so that the total quantity of
water which passes through the weigher
is accurately obtained. This remark-

able weigher is guaranteed to record the correct weight of water to within
 $\frac{1}{2}$ of one per cent. No other device is as accurate.

Write today for our book—Kennicott & Jewell on Filtration and Softening Water.

WM. B. SCAIFE & SONS CO.

Founded 1802

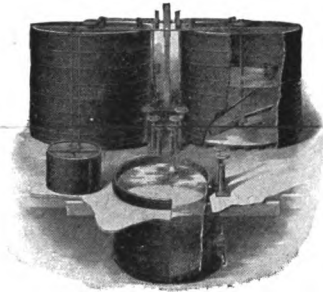
221 FIRST AVENUE, PITTSBURGH, PA.

WATER PURIFICATION FOR ALL PURPOSES: CONTINUOUS AND INTERMITTENT WATER SOFTENING AND PURIFYING SYSTEMS; PRESSURE AND GRAVITY FILTERS AND FILTRATION SYSTEMS

SOFTENING AND PURIFYING SYSTEMS

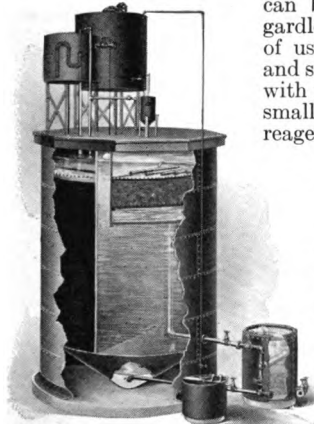
The fundamental features of all our designs of systems are—accurate chemical treatment, thorough mixture of reagents with water, accelerated chemical reaction, rapid sedimentation, and perfect clarification. Design for each installation and performance guarantees are based upon scientific investigation of water supply and uses, supplemented by analysis and treatment of water in own laboratory.

We-Fu-Go System—(Intermittent): In this system definite quantities of water are treated, therefore accuracy of treatment



We-Fu-Go System (Patented)

can be maintained and uniform water obtained, regardless of variations in quality of raw water or rate of use. Consists essentially of two or more reaction and settling tanks, which also act as storage tanks, fitted with mechanical stirring devices operated by power, a small reagent mixing tank, means for introducing the reagents into the reaction tanks, and a quartz filter of either gravity or pressure type. Built for any capacity.



Syphon System (Patented)

Syphon System—(Continuous): An automatic system not dependent upon moving mechanical devices for reagent introduction. The water enters a receiving tank to which is connected a syphon, into the long leg of which smaller syphons connect from the solution tanks. Reagents introduced during the period of syphon discharge. This system can be arranged to be operated either from the ground or from the top.

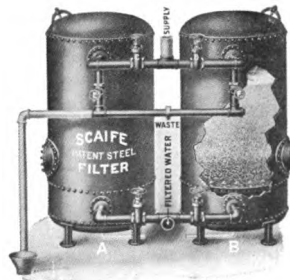
In addition to this system three other standard continuous systems are manufactured and special systems designed where required.

FILTER SYSTEMS

Pressure Filters are adaptable for every purpose and are built in capacities from 20 gallons per hour upward, to withstand any required pressure. When operated in pairs, each filter is cleaned with filtered water, one filter furnishing the water for cleansing the other.

Gravity Filters are built in units with capacities varying from 8,000 to 1,000,000 gallons per 24 hours each. Combinations for practically any capacity with required sedimentation can be furnished.

Patented brass conical strainers and patented valveless coagulant feed apparatus are special features embodied in these filters and filter systems.



Pressure Filters



WARREN WEBSTER & COMPANY

Established 1888

MAIN OFFICE AND FACTORY, CAMDEN, N. J.

BRANCHES

NEW YORK
PITTSBURGH
INDIANAPOLIS
HOUSTON
LOS ANGELES
SAGINAW

PHILADELPHIA
ATLANTA
CLEVELAND
NEW ORLEANS
DENVER
DETROIT

CHICAGO
CHARLOTTE
ST. LOUIS
MINNEAPOLIS
SEATTLE
WILKES-BARRE

BOSTON
CINCINNATI
KANSAS CITY
SAN FRANCISCO
SPOKANE

Sole Representatives and Manufacturers for Canada

DARLING BROTHERS, LTD., MONTREAL

ST. JOHN,

WINNIPEG,

CALGARY,

TORONTO,

VANCOUVER,

LONDON, ONT.

THE ATMOSPHERIC STEAM HEATING CO., LTD., LONDON, ENG.

THE WEBSTER SYSTEMS OF STEAM HEATING

Vacuum

Hilo

Modulation

Having been pioneers in Vacuum Heating and before the engineering world for 27 years there are few in the line who do not know the reputation we have established for excellence of materials and service.

The devices which go to make up a Webster Vacuum or Modulation System are varied in construction and operation so as to meet all requirements, and standing back of each Webster Installation as we do, it is but natural that we prefer to co-operate with the Architect, Engineer or Contractor in the design and construction of the apparatus.



Webster Sylphon Trap

Webster Appliances are furnished as a system basis and although the Sylphon Trap is by far the best water and air relief trap on the market we find many cases where other traps of our manufacture are better adapted to specific cases, so for this reason we would advise those who specify systems of this type to leave the selection of the devices to us, where we are called upon to guarantee results.

The Webster Modulation Valve is made in several types also and can be applied to the supply connection of any kind of radiating surface using steam as a heating medium.

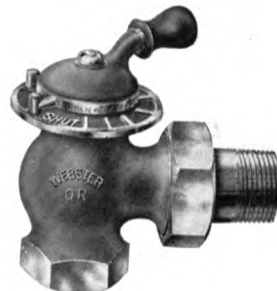
Universal joint — Extended stem valves for radiators beneath seats or behind grills, chain control for overhead radiators or coils have been perfected to a point of absolute success.

The several types of Webster Modulation Valves are used successfully with or without a vacuum pump according to the nature of the building or buildings in which they are installed and where applied and operated according to our instructions make it possible to modulate the temperature of a room by measuring the quantity of steam admitted.

The removal of air and water of condensation from radiators, coils or piping is accomplished successfully without steam leakage. The Webster Sylphon Trap being the most efficient device for that purpose, operating as it does at any pressure or vacuum from 15 pounds above to 15 inches below atmospheric pressure being compensated for pressure.

A perfect balance within this system can be maintained by the application of our Hilo method with which a high vacuum can be carried on trunk lines and lower vacuums on branches, making lifts and difficult situations easy to overcome.

For Convenience and Economy in heating, there is no better method than "The Webster" and with our trained engineering corps, backed by our ability to make good, the slogan that "The Webster Guarantee is the Owners Insurance Policy" is a fact and not a theory.



Webster Modulation Valve

WARREN WEBSTER & COMPANY

WEBSTER FEED WATER HEATERS

The Webster Chemical Purifier is a Feed Water Heater and Purifier of the Hot Process Type using simple and cheap chemicals for the thorough purification of hard scale forming boiler feed waters.

All Webster Feed Water Heaters embody the following special features:

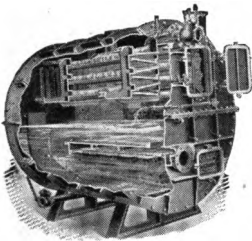
(a) Copper Heating Trays, light, easy to clean, durable and permitting the most intimate intermixture of steam and water because of the small perforations obtainable by the use of this metal.

(b) Open Sink Pans (instead of hollow floats)—for automatically controlling water inlets and overflow—positive in action, cannot become inoperative except by abuse.

(c) Complete segregation of oil separator drips from any connection with other openings into the Heater, thus preventing oil contamination otherwise caused by accident or negligence.

(d) Vacuum Principal: by which the heater assists the passage of steam into itself, thereby reducing back pressure upon engines.

Webster Heaters save (1) Fuel (usually from 10 to 17%) (2) Water (usually from 10 to 14%) as compared with the use of a closed type of Heater or with no heater whatever, (3) Boiler repairs due to boiler strains, and (4) Boiler cleaning expense due to their action as Water Purifiers.



Class ED Standard Type

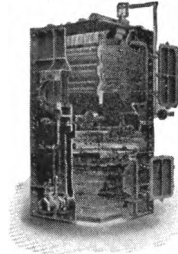
Oil Separator of ample size to purify all steam passing through the exhaust main to both the Feed Water Heater and to a Heating or Drying System or to Low Pressure Turbines.)

Class "EB"—500 to 7000 horsepower capacities—vertical rectangular pattern—upward flow filtration.

Class "EC"—500 to 7000 horsepower capacities—vertical rectangular pattern—upward flow filtration.

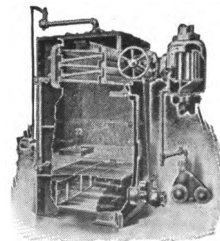
Class "ED"—500 to 15,000 horsepower capacities—horizontal cylindrical pattern (particularly adapted for low head-room) upward flow filtration.

Class "EF"—75 to 450 horsepower capacities—vented rectangular one-piece body type—either upward or downward flow filtration as required.



Class EC Standard Type

WEBSTER OPEN FEED WATER HEATERS are built in all types and sizes for any conditions of service, space, head-room, etc. They can be furnished either Standard Type (induction principle with oil separator attached to heater shell) or Preference Type (the most improved form of Cut-Out Heater using a Gate Valve in connection with an



Class EB Cut-Out Type

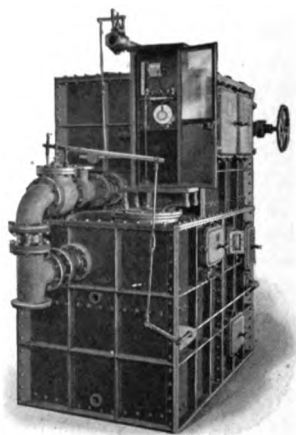
(Continued on next pages)

(Continued from preceding pages)

WARREN WEBSTER & COMPANY

THE WEBSTER-LEA HEATER METER

A practical combination of a thoroughly efficient feed water heater with an accurate V-Notch weir meter so arranged that either unit may be operated with equal efficiency, in combination or independently. Has all the advantages of independent apparatus, as there is no interior connection between the heating chamber and the measuring tank. All floor space and head-room requirements are reduced to a minimum. Division plate between heater and meter prevents direct flow of heated water to meter. Water passes through outside connection which contains a regulating valve operated by a float that is located in the storage chamber for heated and metered water. Flexibility is insured, as either unit may be cut out of service while the other remains in efficient operation. The Patented Extra Storage Type Meter has a large storage chamber for heated and metered water.



Patented and Patents Pending

Absolute meter accuracy results because

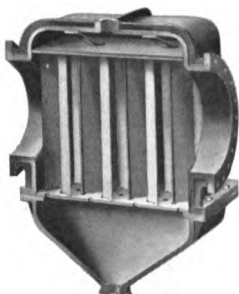
1. The weir cannot be flooded, even if the heater were to overflow.
2. Variations in steam pressure in heater cannot affect water levels in the meter.

66

Made in the following types, of cast iron, wrought iron, steel or special materials:

- (a) For exhaust pressure ranging from atmospheric to one pound.
- (b) Equipped with cut-out valve and Preference Oil Separator, for use in connection with any type of heating system, under normal back pressures.
- (c) Made to withstand abnormal back pressures up to twenty pounds per square inch.

Built in rectangular or cylindrical pattern, or of elliptical section. Fully covered by patents granted and pending.

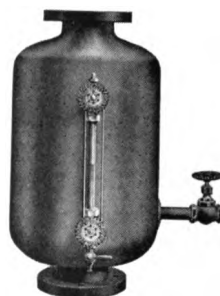


Webster Oil Separator

WEBSTER STEAM AND OIL SEPARATORS

WEBSTER STEAM SEPARATORS for the protection and added economy of engines, turbines and pumps, and Webster Receiver Separators giving in addition a means for permitting smaller piping and for equalizing pulsations, are manufactured in types for any direction of flow (horizontal, vertical or angle), of either cast iron or cast steel, and for high or low pressure.

Webster Oil Separators for either pressure, atmospheric or vacuum conditions and Webster Receiver Oil Separators for use with low pressure turbines or other service are made for horizontal, vertical or angular direction of flow and of several types depending upon operating conditions. Exhaust steam which has passed through any type of Webster Oil Separator may, when condensed, be returned to boilers or used for manufacturing purposes with perfect safety.

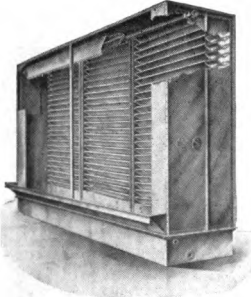


Webster Steam Separator

WARREN WEBSTER & COMPANY

AIR-CLEANSING, AIR COOLING, DE-HUMIDIFYING APPARATUS

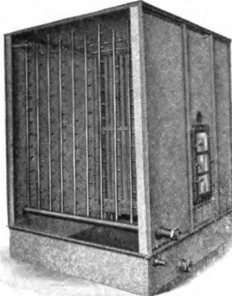
Reclamation of Materials in Connection with Exhaust Systems



The Webster Standard Air Washer

The Webster Standard Air Washer

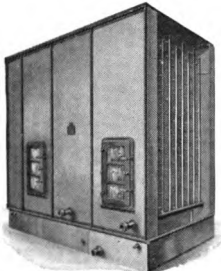
Designed specifically for air cleansing; cooling of the air by evaporation being relatively unimportant. This apparatus commends itself, particularly for the extreme simplicity of its construction, economy of floor space, ease of operation and especially for its effectiveness.



The Webster "Type A" Air Washer

The Webster "Type A" Air Washer

Designed primarily for cooling air by evaporation, the spray water being recirculated. Where a high degree of cooling by evaporation is desired, in addition to Air Cleansing, this apparatus is especially recommended.



The Webster "Type B" Air Washer

The Webster "Type B" Air Washer

Designed primarily for cooling or de-humidifying air by the use of cold well water or water cooled by ice or mechanical refrigeration; it is designed to secure the highest refrigerating effect from the cold spray water. In addition to this it is a most efficient air cleansing apparatus and will cool air, by evaporation, to the saturation temperature. This apparatus is particularly applicable in the special requirements of industrial plants, and where constant temperature, humidity or both are required the year round.

The Webster System of Automatic Humidity Control

May be readily applied to the various types of Webster Air Washers. Perfect in principle and accurate in operation. Possesses features that make it practical and simple, among which may be mentioned:

1. Separate control, by ordinary thermostats, of the average dry and wet-bulb temperatures of air leaving the Air Washer.
2. Independent of unequal air and spray distribution and temperature, ordinarily causing unequal humidifica-

tion, supersaturation, inaccurate results, etc.

3. Quick response — the chief controlling thermostat subject to water, a medium with four times the specific heat of air.

4. Inherently safe against over humidification.

Consult us regarding Air Conditioning Apparatus for any purpose.

THE GRISCOM-RUSSELL CO.

Successors to THE GRISCOM-SPENCER CO., THE RUSSELL ENGINE CO.,
and THE JAMES REILLY REPAIR AND SUPPLY CO.

NEW YORK

PHILADELPHIA

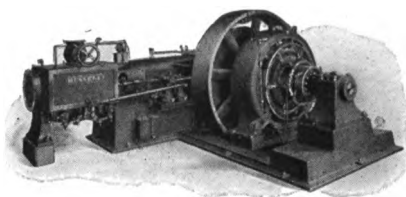
CHICAGO

SAN FRANCISCO

ENGINEERS & MANUFACTURERS
LAND & MARINE

POWER PLANT EQUIPMENT
STEAM SPECIALTIES

15 H. P.
to
2000 H. P.



Russell Four Valve Engine

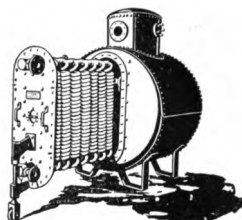
Single Valve
Four Valve
Simple Com-
pound
Side Crank



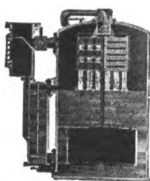
Reilly Multicoil
Feed Water
Heater

Highest efficiency per square foot of heating surface. Every coil may be inspected without breaking pipe joints. Coils tested to 300 pounds. Millions of horse power capacity in daily use.

Pure Water without scale difficulty. Easily cleaned—require small space. All coils pure copper—no brazing—interchangeable.



Reilly Multicoil Evaporator



Massillon Open
Feed Water Heater

This heater is of cast iron construction throughout. Has by-pass integral with oil separator. Large scale trays—upward filtration—ample storage capacity.

We also manufacture and sell a complete line of steam and oil separators, feed water filters, fuel oil heaters, oil coolers and other specialties.



Write for Catalogues

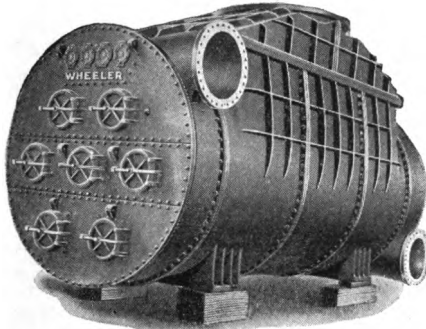


WHEELER CONDENSER AND ENGINEERING CO.

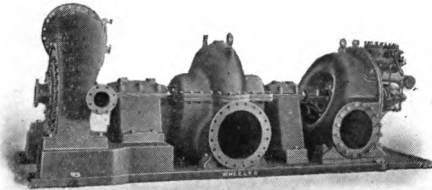
MAIN OFFICE AND WORKS: CARTERET, NEW JERSEY

BRANCHES: NEW YORK, BOSTON, PHILADELPHIA, CHICAGO, ST. LOUIS, ST. PAUL, CINCINNATI, PITTSBURGH, DALLAS, CLEVELAND, DENVER, SAN FRANCISCO, SALT LAKE CITY, LOS ANGELES, SEATTLE, TUCSON, ARIZ., CHARLOTTE, NEW ORLEANS, ATLANTA, LONDON, YOKOHAMA, TRIESTE, MELBOURNE, PARIS.

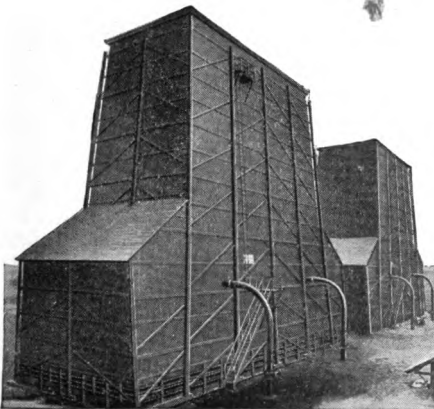
MANUFACTURERS OF COMPLETE CONDENSING EQUIPMENT



Wheeler High Vacuum Surface Condenser



Wheeler Complete Single-Drive Auxiliaries for
Surface Condenser



Two Wheeler-Balcke Cooling Towers; Capacity
600,000 Gallons per Hour

HIGH VACUUM SURFACE CONDENSERS

For turbines of any capacity, condensing equipments operating on wet or dry system, with tube surface of condenser arranged to give best distribution of steam for high efficiency and maximum rate of heat transmission.

HIGH VACUUM JET CONDENSERS

For turbines of any size to maintain vacuum of 28 inches and up. Built on the countercurrent "rain type" principle to insure maximum temperature of discharge water, and therefore, minimum quantity of water, and minimum pumping cost.

WHEELER TURBO AIR PUMPS

High Speed Rotary type for jet or surface condensers. Direct connected to turbine or motor. Combined with condensate pump and circulating pump all driven by one turbine. Will maintain 99% vacuum.

WHEELER-EDWARDS AIR PUMPS FOR AIR AND CONDENSATE

Eliminate expense of independent air and hot well pumps. No suction or bucket valves.

WHEELER ROTATIVE DRY VACUUM PUMP

Will maintain a vacuum within .5" of barometer. For high vacuum jet condensers and large surface condensing equipments. Clearance effect reduced by an equalizing port.

CENTRIFUGAL PUMPS FOR ALL SERVICES

Circulating, tail water and hot well pumps for condensers and high efficiency single stage pump for all purposes. Pumps of all sizes driven by motor, steam turbine or engine for water works, irrigation, etc.

FORCED DRAFT STEEL TOWERS

Recommended for efficient cooling of water where ground space is limited, and smallest size tower must be used.

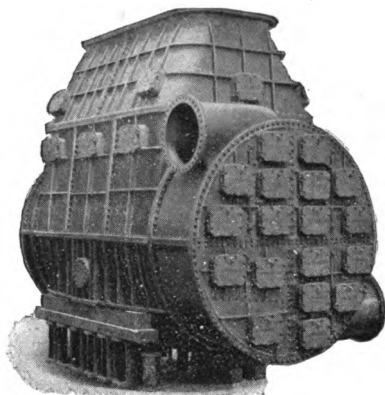
NATURAL DRAFT WOODEN TOWERS

For manufacturing and industrial plants, also central stations where a supply of cooling water is not available. Operating cost consists of water pumping cost only. Designed for special low lift so as to reduce this cost to the minimum.

HENRY R. WORTHINGTON

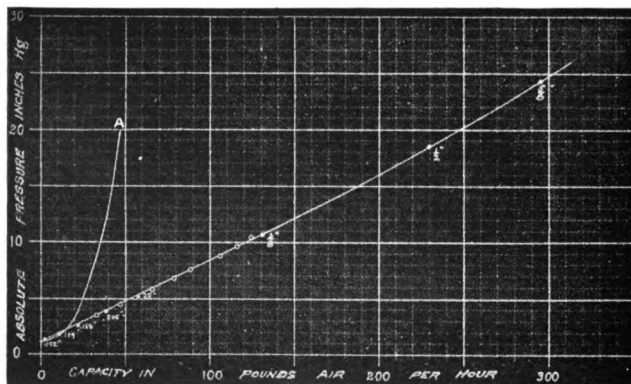
115 BROADWAY, NEW YORK WORKS, HARRISON, N. J.

MANUFACTURERS OF SURFACE, BAROMETRIC AND CENTRIFUGAL JET CONDENSING SYSTEMS, COMPLETE WITH AUXILIARIES FOR HIGH VACUUM WORK; COOLING TOWERS; DUPLEX DIRECT-ACTING, CENTRIFUGAL, TURBINE PUMPS FOR EVERY SERVICE; BOILER FEED, ELEVATOR, FIRE, PRESSURE PUMPS; WATER METERS; WATER WORKS, SEWAGE AND DRAINAGE PUMPING ENGINES



WORTHINGTON SURFACE CONDENSER

Containing 35,000 square feet of surface—one of two now being installed each in connection with one 20,000 Kw. Curtis Turbine by the Edison Illuminating Company of Detroit in their new Connor's Creek Power Station.



WORTHINGTON HYDRAULIC VACUUM PUMP CAPACITY-PRESSURE CURVES

Showing points for determination with accurately measured air quantities. Curve "A" represents the performance of the usual type of competitive hydraulic vacuum pumps as taken from published tests reproduced to scale.

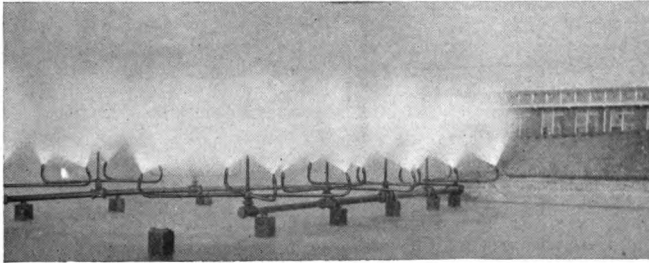
W280.8

SPRAY ENGINEERING COMPANY

93 FEDERAL ST., BOSTON, MASS.

ENGINEERS—MANUFACTURERS

SPRAYS FOR COOLING CONDENSING WATER



Spray Cooling Ponds equipped with our special Spray Cooling equipment require only from five to seven pounds pressure per square inch at the nozzle. With this pressure, the water is thrown to a height of from five to seven feet above the tip of the nozzle in a uniform dense conical spray. When there is no wind, a current of air is created in an upward direction around each nozzle due to its driving effect as well as to the heating and humidifying effect which the spray has on the air in contact with the water, thus rapidly carrying away the warm moist air produced and replacing it with cool dry air brought in over the surface of the pond.

Our Spray Cooling Ponds are more efficient in extremely hot weather when high humidity prevails than in cool weather with low humidity, that is, we can cool to the wet bulb under the former conditions but not under the latter.

We find from our experience in designing over two hundred and fifty ponds, now in successful operation in the United States and other countries, that it is impossible to lay down exact rules for the design of these ponds, as local conditions make each case a special problem. Hence, if the amount of water to be cooled, the amount of steam condensed in heating this water, the cooling or vacuum desired, as well as the dimensions of the space available for the installation and whether on ground or roof are given us we will be pleased to send complete specifications and blue print of arrangement, best suited to conditions given.

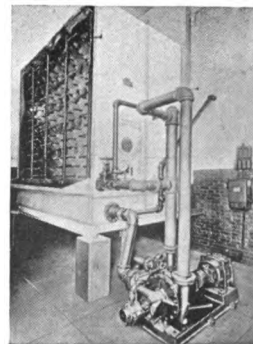
AIR WASHERS FOR STEAM TURBINE GENERATORS

As the capacity of the electric generator is directly dependent upon its temperature, which in turn depends upon the air conditions, an ample supply of cool, clean air is of great importance. Dust or soot deposited within the machine greatly reduces the efficiency of air as a cooling medium.

As generators usually reach maximum efficiency at or above full load, the Spray Washers produce the double benefit of high efficiency and full rated capacity. Cooling the entering air from 90° F. to 70° F., which can be done with air at a relative humidity of from 35 to 40%, results in increasing the capacity of the generator by approximately 18%.

An average gain of only 5% on a 5,000 kw. machine means an increased capacity of 250 kw. At \$20 per kilowatt per annum this gives \$5,000 increased earning capacity in one year. The increase for three months—\$1,250—would about cover the cost of the air washer, which would thus pay for itself quickly, and then provide a very large return on the investment.

The cost of cleaning a large generator is high and where the air is unwashed, must be undertaken at least twice a year. This can be largely avoided by the use of the Spray Air Washers.



MORTON VACUUM BREAKER CO.

HYDE PARK, BOSTON, MASS.

VACUUM BREAKERS FOR JET CONDENSING ENGINES AND TURBINES

THE MORTON VACUUM BREAKERS are designed to positively prevent the condensing water from a jet condenser from entering the cylinder of an engine or entering a turbine and causing serious damage. These Vacuum Breakers were brought about through experience with numerous disastrous accidents to jet condensing engines. *Made in different types for all conditions.*

Plate 1 is a combination vacuum breaker and non-return valve and forms a portion of the exhaust pipe. This type must be placed in a vertical exhaust pipe and operates in the following manner:

The steam flows in the direction of the arrow (W). The receptacle (B) is two inches larger in diameter than the exhaust pipe and is held in an upward position against the stop (A) by the weight (1). When the engine is running, all of the condensation which may drop into the receptacle (B) runs out through a one-half inch hole at "C," and does not accumulate. When water flows back down the exhaust pipe in the direction of "X," it must enter the receptacle (B) which holds from forty-five to one hundred pounds of water, according to the size used, and a few pounds of water will cause the receptacle to move downward and, as the leverage between the receptacle and knife edge (J) and bearing point (K) is three to one, the air valve (F), which is one inch in diameter, having a 45 seat, is easily lifted against the atmosphere. This gives the weighted arm (M) a throw which readily drops, and as its short arm comes in contact with top of slot in valve stem (N) it will pick up the two or three-inch air valve (G), which has a 45 seat or whatever size air inlet valve is used. When the receptacle is one-quarter full of water there is power enough to lift the large valve (G) against the atmosphere, and before the receptacle (B) is full of water, there is an effective power at "K" of one hundred pounds more than is necessary to lift the large valve (G) against the atmosphere. As soon as the receptacle (B) starts downward, having a valved bottom, it engages the brass seat (T) and entirely closes the exhaust pipe. Should water continue to flow down the exhaust pipe from a forced injection it will run out through valve (G). After the valve has operated, the water must be drawn out through the opening (O), the vacuum broken between the valve and the engine and after the receptacle empties through "C" and "O" it will rise to the stop (A) and the weight (M) must be lifted by hand.

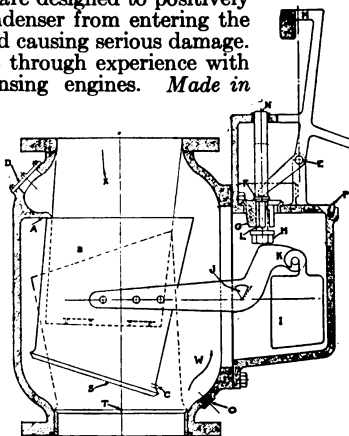


Plate 1—Morton Vacuum Breaker, Combination Vacuum Breaker and Non-Return Valve

This breaker should be placed so that in case an engine is warmed up and the exhaust pipe is full of condensation, not being properly drained, the first pressure of the exhaust steam will raise the water up in the vertical exhaust. The steam in the cylinder condenses (while warming up) and the water starts to flow back into the cylinder, when the receptacle, by the weight of the water which enters it, will immediately close the passage-way and prevent the atmospheric pressure in the exhaust pipe from forcing the water back into the cylinder as condensation takes place, thus notify the operator of the presence of water in the exhaust pipe, thereby averting an accident.

No stuffing boxes—No parts to stick or vibrate.

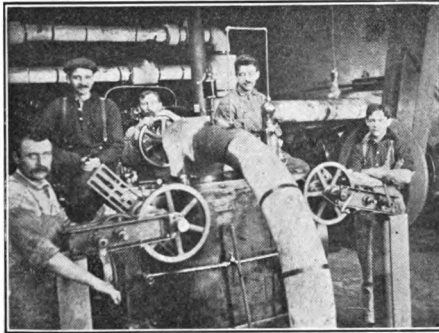
Provision is made to attach engine stop to arm (M) so that when the stop operates the vacuum will be automatically broken.

C. F. WENDLAND ENGINEERING AND CONSTRUCTION CO.

61-63 WOOSTER ST., NEW YORK

NEW INSTALLATIONS AND EMERGENCY REPAIRS

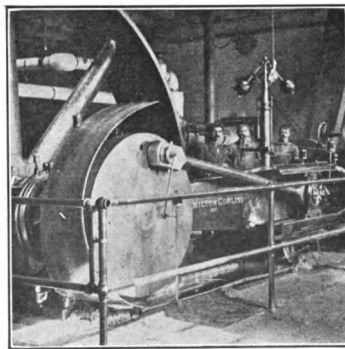
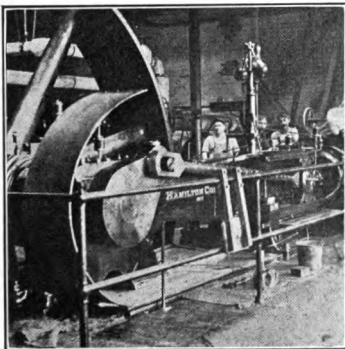
Complete installations for entire power plant—steam and electric.
General repairing to entire steam, electric and refrigerating plants.



**Boring Valve Ports and Cylinder of 24"x48" Corliss
Engine**

Engine and pump cylinders rebored and crank pins turned in position.
Valves reseated and repaired in position.
Engines indicated and valves adjusted.
Boilers retubed and reset—steam and hot water heating.
Repair shop ready for operation day or night.

Our large force of skilled workmen and accurate portable tools can completely overhaul every boiler, engine, ice machine, pump, compressor, generator, motor or other machinery right in your own plant. All work is positively guaranteed and backed by years of experience in this field.



Altering 24"x48" Corliss Engine from Bell Crank to Balance Disc Crank

CRANE CO.

Founded by R. T. Crane 1855

836 So. MICHIGAN AVE., CHICAGO, ILL.

Cable address, Crancocoy, Chicago.

Branches in Forty-four Cities.

CAST STEEL VALVES AND FITTINGS; CRANETILT STEAM TRAPS; VALVES, COCKS AND FITTINGS IN BRASS, MALLEABLE IRON AND CAST IRON; STEAM SPECIALTIES; COMPLETE PIPING EQUIPMENT; PIPE BENDS; PIPE FITTERS' TOOLS; ENGINEERS' SUPPLIES, ETC.

CRANE CAST STEEL VALVES AND FITTINGS

We have been manufacturing for some time a line of steel fittings to meet a steadily growing demand for a superior grade of goods, especially adapted for High Pressure, Saturated and Superheated Steam Lines and Extreme Hydraulic Service. These are suitable for steam working pressures up to 350 pounds, and for superheat up to a total temperature of 800 degrees.



No. 7A
Straight-Way Valve, cast steel body, bonnet, yoke and disc (sizes above 2 inch, disc monel metal faced; 2 inch and smaller, solid monel metal disc) monel metal seats and rolled monel metal stem.

Nos. 21A, 23A and B, 27A, 29A and B
Globe and Angle Valves, cast steel body, yoke and swivel disc (sizes above 3½ inch, disc monel metal faced; 3½ inch and smaller, solid monel metal disc) monel metal seats and rolled monel metal or steel stems.

No. 101D and No. 105D
Extra Heavy Cast Steel Flanged Fittings.

We carry the following steel goods in stock:

No. 7A Straight-Way Valves	} 12 inch and smaller
Outside screw and yoke, monel seats, rolled monel metal stem . . .	
No. 9A Straight-Way Valves	} 14 inch and smaller
Outside screw and yoke, monel seats, rolled monel metal stem . . .	
No. 21A Globe Valves	} 6 inch and smaller
Outside screw and yoke, monel seats, rolled monel metal stem . . .	
No. 23A and B Angle Valves	} 6 inch and smaller
Outside screw and yoke, monel seats, rolled monel metal, or cold rolled steel stems	
No. 101D Steel Flanged Elbows	} 12 inch and smaller
Straight sizes	
No. 105D Steel Flanged Tees	} 12 inch and smaller
Straight sizes	
Screwed Elbows	} 4 inch and smaller
Straight sizes	
Screwed Tees	} 4 inch and smaller
Straight sizes	

Further particulars will be found in our Special Steel Catalogue.

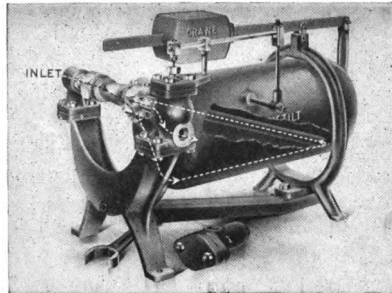
CRANE CO.

CRANETILT STEAM TRAPS

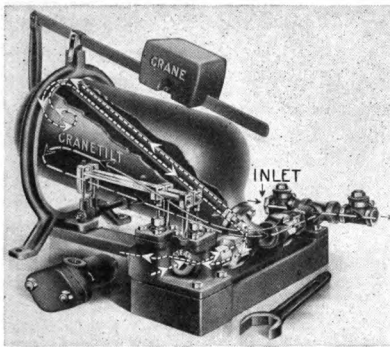
NON-RETURN PATTERN

The receiving or tilting tank is made of malleable iron, cast in one piece of uniform thickness. They are tested to 800 pounds hydraulic pressure per square inch and are fully capable of withstanding the severe strains to which Tilting Traps are subjected.

All operating parts are on the outside and the discharge Valves are of special design, having exceptionally large openings. The brass working parts are made of "Crane Hard Metal" which has wearing qualities almost equal to steel and successfully resists the cutting effects of steam and water.



		Pipe Connections	Capacities per Hour Based on Ordinary Condensing Conditions		Dimensions	
Size of Trap Number	List Price including Sediment Trap, but no Check Valves or Fittings	Size of Inlet and Outlet Inches	Lineal Feet of 1 Inch Pipe Trap will Drain with 50 lbs. Pressure at the Trap	Pounds of Water Discharged with 50 lbs. pressure at the Trap	Over All Inches	Extreme Height Inches
30	\$25.00	¼	6,000	1,200	19½x12	19¾
32	45.00	½	15,000	3,000	24½x14⅝	24½
33	55.00	¾	30,000	6,000	28 x18¼	28
34	85.00	1	50,000	10,000	32½x20½	31
35	115.00	1¼	75,000	15,000	36 x23	33
36	150.00	1½	100,000	20,000	42 x25½	36
37	200.00	2	150,000	30,000	47½x29⅛	41
38	300.00	2½	200,000	40,000	54 x33⅞	50
39	425.00	3	250,000	50,000	61 x37¾	56



DIRECT RETURN PATTERN

This pattern will automatically return all condensation, at any pressure or temperature, directly back into the boiler. Direct Return Traps require live steam from the boiler for their operation, which is automatically controlled through the steam port of the Duplex Valve. Cranetilt Steam Traps will handle condensation from all sources, under any condition of service, and under any pressure up to 250 pounds. They also have a maximum discharging capacity. Each trap is given a thorough steam test and guaranteed in perfect working order before shipment.

Size of Trap Number	List Price including Sediment Trap, Two Swing Check Valves, Tee and Nipples	Pipe Connections		Capacities per Hour Based on Ordinary Condensing Conditions		Dimensions	
		Size of Water Inlet and Discharge Inches	Size of Steam and Vent Valves Inches	Lineal Ft. of 1 Inch Pipe Trap will Drain	Pounds of Water Trap will Discharge into Boiler	Over All Inches	Extreme Height Inches
90	\$60.00	1/2	1/2	4,000	800	25 x 15 3/4	27
91	75.00	3/4	3/4	7,500	1,500	28 1/4 x 19 1/4	31
92	100.00	1	1	12,500	2,500	33 x 21 3/4	36
93	150.00	1 1/4	1 1/4	18,000	3,600	37 1/2 x 24 1/2	38
94	200.00	1 1/2	1 1/2	25,000	5,000	42 1/2 x 27	42
95	300.00	2	2	39,000	7,800	51 1/2 x 30 1/4	50
96	400.00	2 1/2	2 1/2	57,500	11,500	60 x 34 1/4	55
97	550.00	3	3	77,500	15,500	68 x 38 3/4	65
98	750.00	4	3	140,000	28,000	76 x 44 3/4	70

(See also following pages)

(Continued from preceding pages)

CRANE CO.

CHICAGO, ILL.

SUMMARY OF CRANE PRODUCTS

We give on this and the succeeding page a description of our line. We carry in stock at our branch houses a large supply of the goods listed below and are prepared to furnish Special Valves, Fittings, etc., to meet specific requirements or conditions, without delay.

The term Standard is applied to those goods intended for steam working pressures not exceeding 125 pounds. The Low Pressure Fittings, etc., may be used for Steam Working Pressures up to 25 pounds, while the Medium Goods are intended for 175 to 225 pounds. The Extra Heavy are designed for Steam Working Pressures up to 250 pounds.

The proportionate Water Working Pressure may be taken as follows: Low Pressure, Standard and Medium, 40 per cent greater than the steam pressure on sizes 12 inch and smaller; sizes 14 inch and larger, 20 per cent greater.

STANDARD GOODS

We manufacture brass Globe, Angle and Cross Valves, screwed, in sizes from $\frac{1}{8}$ to 4 inches; and the flanged pattern from $\frac{3}{4}$ to 4 inches. The brass Check Valves are made in many patterns, the sizes of which run from $\frac{1}{8}$ to 3 inches. The brass line also includes: Hose, Garden Hose, Coke Oven, Needle Point, Straight-Way and Hose Gate. Our lines of Radiator Valves and Fittings, brass Steam and Gas Cocks are complete. The Cast Iron Fittings include Cocks of various patterns; Globe, Angle and Cross Valves with yoke as well as the regular patterns; the sizes of the latter ranging from $\frac{1}{2}$ to 3 inches. We handle Brass and Cast Iron Pipe Fittings in both the screwed and flanged patterns as well as Malleable Pipe Fittings screwed. With the Standard Goods are also included iron Straight-Way Valves, Expansion Joints with iron body and brass sleeve, Railing Fittings, Drainage Fittings, Steam Fitters' and Engineers' Tools, Pipe Bends, and Pipe Supports, Brackets, etc.

LOW PRESSURE GOODS

The regular low pressure Straight-Way or Wedge Gate Valves are made in several patterns and in sizes up to 72 inches. The low pressure Pipe Fittings are of the flanged pattern and include Elbows, 45 degree Elbows, Tees, Reducing Tees, Crosses, Reducing Crosses, Long Radius Elbows, Square and Round Base Elbows and Taper Reducers.

MEDIUM PRESSURE GOODS

This line includes the Crane Navy Globe, Angle, Cross and Check Valves made of Crane Special Brass; the screwed pattern being made in sizes ranging from $\frac{1}{4}$ to 4 inches and the flanged pattern from $\frac{3}{4}$ to 4 inches. The brass Straight-Way or Wedge Gate Valves come with non-rising stems, either screwed or flanged, while the rising stem pattern has a yoke and is screwed. We also make in the medium class, Globe, Angle and Cross Valves with Ferrosteeel body, flanged in sizes ranging from 2 to 12 inches; the Straight-Way or Wedge Gate Ferrosteeel Valves are made in sizes up to 24 inches.

CRANE CO.

EXTRA HEAVY GOODS

Under this heading will be found Ferrosteel Straight-Way Valves in ten patterns, including the Electrically and Cylinder Operated Design; the sizes run up to 24 inches and larger. The Ferrosteel Globe, Angle and Cross Valves are made with yoke, have hard metal seats and are flanged; the sizes range from 2 to 15 inches. The Extra Heavy Valve line also includes Swing Check Valves, flanged sizes from 2 to 15 inches; Automatic Stop-Check Valves in Globe and Angle Pattern, flanged, sizes 2 to 10 inches; Expansion Joints—iron body and brass sleeve, in sizes 2 to 18 inches—these are also made with special traverse and extra long traverse; Balanced Expansion Joints; Globe, Angle, Cross and Check Valves; Regrinding Swing Check Valves; Horizontal Check Valves; Unions, Rough Brass Fittings, Malleable Iron Fittings, Cast Iron Flanged Fittings, Gaskets, Flanged Pipe Joints.

HYDRAULIC GOODS

The complete line includes material for various water working pressures up to 10,000 pounds, depending upon the article. It includes Straight-Way Valves with non-rising stem and with outside screw and yoke, with or without by-pass in sizes 1½ to 12 inches; Swing Check Valves in sizes 2½ to 12 inches inclusive; Globe, Angle and Check Valves, Malleable Iron Fittings, Brass Unions, Ferrosteel Flanged Fittings and Companion Flanges, Cast Steel Valves, Fittings and Flanges and Forged Steel Fittings.

PIPE

We can supply promptly Seamless Drawn Brass and Copper Tubing in iron pipe sizes, Standard Weight Spiral Riveted Pressure Pipe, Straight Steam Steel Riveted Pipe, and Wrought Pipe—either black or galvanized.

SPECIALTIES AND TRIMMINGS

These are Automatic Exhaust Relief Valves, Automatic Stop-Check Valves, Chicago and Navy Unions, Boiler Fittings, Crane Cement for making tight pipe joints, Steam Whistlers, Water Gauges, Oil and Grease Cups, Lubricators, Cocks, Pressure and Vacuum Gauges, Fusible Plugs, Back Pressure Valves, Lever Safety Valves, Pop Safety Valves, Blow-Off Valves, Blow-Off Crosses, Pressure Regulators, Float Valves, Exhaust Pipe Heads, Injectors, Automatic Duplex Feed Pumps and Receivers, Pumps, Flexible Joints, Klingerit Packing, E. C. & B. Pipe Machines, Steam and Oil Separators, Crane Vacuum Oil Separators, Machine Bolts.

POCKET CATALOGUE

We have just issued a new edition which will be found very complete and useful. It is designated as No. 40 and dated September, 1914.



THE DARLING PUMP & MFG. CO. Ltd.

WILLIAMSPORT, PA.

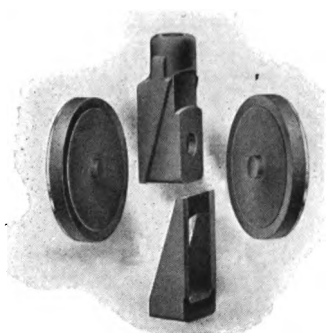
NEW YORK CITY
149 Broadway

SALES OFFICES:
CHICAGO
The Rookery

PHILADELPHIA
Commercial Trust Bldg.

**MANUFACTURERS OF DARLING GATE VALVES, BALL CHECK VALVES
FIRE HYDRANTS, FLOOR STANDS, INDICATOR POSTS, VALVE BOXES**

THE DARLING GATE VALVE



**Wedging Mechanism—Shown with
Parts Separated**

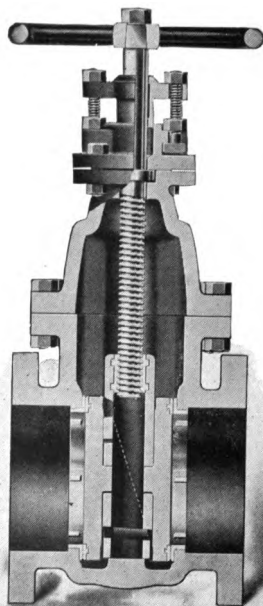
The Gate Discs being plain, no portion of the Wedging Mechanism is formed upon them. These Gate Discs revolve independently of the wedges, and independently of each other. The Revolving Gate Discs change their positions on the Seats each time the Valve is closed, thus distributing wear equally over entire faces of Gates and Seats, ensuring durability.

Gates released before opening, avoiding wear on Seats. Cannot stick or bind.

Simple, reliable, durable.

Darling Valves will remain tight longer than any others. They are made for all pressures and purposes.

The Darling Patented Gate Valve differs from all others in that it has Parallel Seats, Double Revolving Gate Discs and Compound Equalizing Wedges. The Wedging Mechanism operates between the Gate Discs and independent of them.



**Sectional View of Inside Screw Valve
with Flanged Ends**

FOSTER ENGINEERING CO.

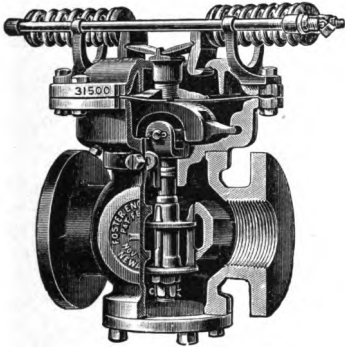
NEWARK, N. J.

BRANCH OFFICES: CHICAGO, PHILADELPHIA, BOSTON, PITTSBURGH

MANUFACTURING ENGINEERS OF AUTOMATIC VALVE SPECIALTIES

PRODUCTS: PRESSURE REGULATORS (Reducing Valves), PUMP GOVERNORS (different styles for different purposes), for steam, water, gas and air. HYDRAULIC REGULATING and RELIEF VALVES, for high and low pressures. AUTOMATIC FREE EXHAUST or RELIEF VALVES; BACK PRESSURE VALVES; FAN ENGINE REGULATORS, for controlling speed of fan by pressure in boiler. LEVER BALANCED VALVES; FLOAT VALVES, auxiliary-operated and direct-connected. AUTOMATIC NON-RETURN STOP VALVES; AUTOMATIC NON-RETURN EMERGENCY STOP VALVES, for saturated and superheated steam—semi-steel and cast steel bodies, and other kindred devices. Over 60 different styles. Also design valves for special services.

PRESSURE REGULATOR—CLASS "W"



For maintaining a Constant Uniform Delivery Pressure from a Higher Initial Regardless of Variations in the Boiler Pressure or Source of Supply. For Service on Steam, Water, Gas and Air.

Its "compensating spring and toggle lever arrangement" makes it phenomenally sensitive, accurate and reliable. Has no weights, levers, or close-fitting piston or parts to cause friction. Very simple in construction and adjustment. Made in sizes $\frac{1}{2}$ -inch to 1-inch of composition, larger sizes, iron body, composition mounted. Sizes $2\frac{1}{2}$ -inch and up are fitted with *renewable seats* forged steel stem and levers—insuring *durability* and *minimum repairs*. Thousands are in use today in all civilized countries and is the "standard" of many large power and manufacturing plants.

FOSTER CLASS "G" PRESSURE REGULATING VALVE FOR INTERMITTENT SERVICE

A decided innovation, so extremely sensitive and withal so reliable that delivery pressure may be adjusted from zero to within a fraction of the initial pressure, and at point of adjustment the delivery will remain constant regardless of variation in initial pressure or volume of discharge.

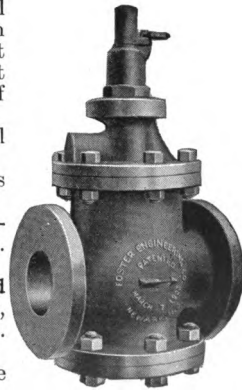
Will operate equally well on horizontal or vertical pipe; upright, inverted or inclined at any angle.

Although of wide range of operation, no part of this valve is of delicate construction or easily deranged.

Orders should state initial and delivery pressures, connections, service and approximate volume of discharge. (See below.)

Made in all sizes, $\frac{1}{2}$ -inch to 12-inch. Sizes 2-inch and smaller of composition only. Larger sizes, iron body, composition trimmed. Screwed and flanged connections. Also make larger sizes in composition on order only.

Prices on application. Write for General Catalogue No. 20.



ORDERS FOR PRESSURE REGULATING VALVES SHOULD SPECIFY:

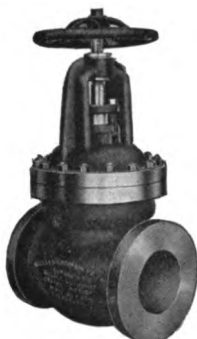
1. Initial or boiler pressure.
2. Maximum and minimum delivery pressure.
3. Connections—screwed or flanged ends, giving diameter.
4. Sizes of both pipes leading to and from regulator.
5. Device or system to which it is to be applied.
6. For high or low pressure service.
7. Size of valve preferred and if we will be permitted to send a smaller size if we deem a smaller valve will give better results. By following our suggestions we often save considerable money for our users.
8. Any additional information towards an intelligent understanding of your requirements will insure your receiving a valve best suited to meet conditions.

GOLDEN-ANDERSON VALVE SPECIALTY COMPANY

1228 FULTON BLDG.

PITTSBURGH, PA.

STEAM AND WATER SPECIALTIES



Triple Non-Return
Valve

AUTOMATIC DOUBLE-CUSHIONED TRIPLE- ACTING NON-RETURN VALVES

(Angle or Globe)

"Works Both Ways;" automatically protects the boilers and steam lines.

They will prevent one boiler working at a lower pressure than another; also should a tube burst, they will instantly shut off the flow of steam from the other boilers into the injured boiler.

The Automatic Safety Stop Feature protects life and property in case a break or rupture occurs in the main steam line or branches. The valves will automatically cut off the flow of steam from the boilers until the break is repaired. Made in sizes to 12".

1200 of these were ordered by the U. S. Steel Corp. for the protection of their power plants.

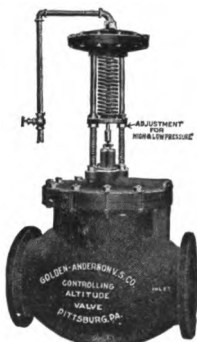
AUTOMATIC CONTROLLING ALTITUDE VALVES

These are intended for automatically maintaining uniform stage of water in tanks, standpipes or reservoirs and do away with the annoyance of floats or fixtures. They are especially adapted for water works and railroads.

These valves can be used with either high or low pressures and may be closed automatically by water, by electricity or by hand.

In addition to the type illustrated we build valves with electrical attachments that can be quickly closed by means of a direct or alternating current. The solenoids are attached directly to the valves and wired up to switch at pumping station or switches at various location, thus permitting instant operation.

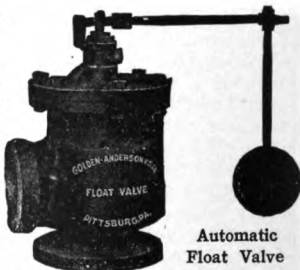
Altitude Valves are made in either the angle or globe pattern. 24 inches and smaller.



Automatic Controlling
Altitude Valve

AUTOMATIC FLOAT VALVES

are instantly adjusted to operate Quickly or Slowly as desired. Indestructible. They are absolutely the only Satisfactory Float Valve Known for High or Low Pressure. 24 inches and smaller.



Automatic
Float Valve

AUTOMATIC CUSHIONED WATER PRESSURE REGULATING VALVES

24" and smaller.

We make the largest, heaviest and most correct mechanically constructed and operated line of Automatic Valves for high or low pressure steam and water service in the United Staest.



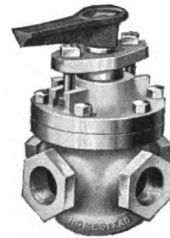
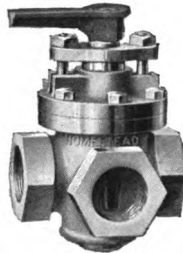
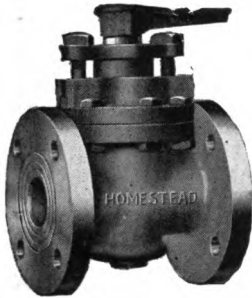
Automa tic Regulating Valve



HOMESTEAD VALVE MFG. CO.

P. O. Box 1754, PITTSBURG, PA.

HOMESTEAD PLUG VALVES (Quarter Turn) OR COCKS



The first illustration shows our Homestead Straightway Valve, with flanged connections. This pattern is used extensively as a boiler blow off valve.

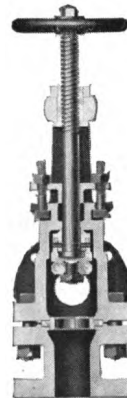
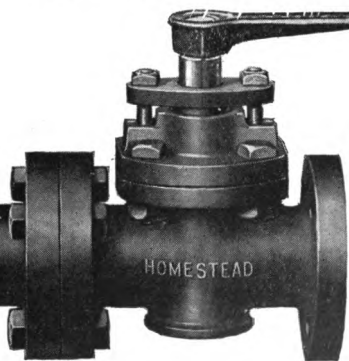
Homestead Valves are equally serviceable on all kinds of exacting or high pressure work.

The three-way and four-way valves as shown on the second and third illustration are used as operating valves on air, water, steam and for many other purposes.

Homestead Valves are so constructed that they open and close with a quarter turn, operate easily and are free from leakage through the valve, the stuffing box or body.

HOVALCO (Blow Off) VALVE

The valve here shown is a new pattern angle blow-off valve, Semi-steel body, monel metal seat and disc. The disc and seat are reversible, renewable and can be re-ground, note the accessibility and the ease with which the ports of this valve can be renewed.



Hovalco Valve

This figure shows the "Homestead" and "Hovalco" valve combined. For boiler blow-off purposes, no better arrangement can be secured. The advantages of the double blow-off arrangement are many, the "Hovalco Valve" can be repaired or re-

newed at any time without closing down the boiler. This is done by closing the "Homestead Valve," while the repairs are being made. The best power plants being built are specifying this arrangement of blow off valves.

Catalogue of our complete line sent upon request.



JENKINS BROS.

80 WHITE ST., NEW YORK

524 ATLANTIC AVE., BOSTON

133 NO. SEVENTH ST., PHILADELPHIA

300 W. LAKE ST., CHICAGO

JENKINS BROS., LIMITED

103 St. Remi St., Montreal

95 Queen Victoria St., London, E. C.

JENKINS RUBBER CO., ELIZABETH, N. J.

**MANUFACTURERS OF JENKINS BROS. VALVES
PACKING AND OTHER MECHANICAL RUBBER GOODS**



Fig. 352
Sectional Views of
New Standard
Pattern Brass
Swing Check Valve

JENKINS BROS. BRASS VALVES

Jenkins Bros. Brass Valves, Standard Pattern, are made in globe, angle, cross, check, safety, Y and radiator patterns. They are the original renewable disc valves.

The Jenkins Bros. Discs, with which they are fitted, are of special rubber composition, readily adapting themselves to the raised seats ensuring absolutely tight closure. As there is no metal against-metal contact of seats, there is less abrasion and wear, and the labor of regrinding is obviated. Jenkins Bros. Discs are inexpensive, give long service, and when worn out can be readily renewed without removal of valves from piping. As regularly supplied, valves are fitted with discs of hard composition for steam service. For cold water, air or gas, discs of softer composition are recommended. The valves are guaranteed for working steam pressures up to 150 pounds.

JENKINS BROS. IRON BODY VALVES

Jenkins Bros. Iron Body Valves, Standard Pattern, are made in globe, angle, cross, check, Y, safety and back pressure patterns. They are heavy and strong. The working parts are similar in construction to the standard pattern brass valves, and they are regularly fitted with Jenkins composition discs. All parts, including raised seat, are interchangeable and renewable. Guaranteed for working steam pressures up to 150 pounds.

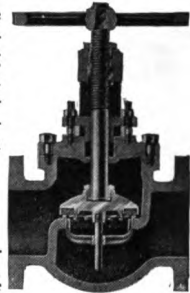


Fig. 162
Sectional View of
Iron Body Globe
Valve Extra Heavy
Pattern

JENKINS BROS. EXTRA HEAVY VALVES

Jenkins Bros. Extra Heavy Valves are designed for 250 pounds working pressure. The Globe, Angle and "Y" or Blow-off Valves are made in brass, either screwed or flanged, sizes $\frac{1}{4}$ to 3 inches, and iron body 2 to 12 inches inclusive. The valves are well designed, made of the very best steam metals, and great care is taken with the workmanship.

The spindles are large and have powerful Acme standard threads. The stuffing boxes are also large and arranged so that they can be packed under full pressure when wide open. They are fitted with renewable steam metal discs when used for steam, with Jenkins Discs for cold water service, and also have removable seat rings which can be reground or renewed when necessary.

A full line of Extra Heavy Horizontal, Angle and Swing Check Valves is also made equally heavy in design and can be recommended as being fully adapted to the service required.

As regularly made, all these Extra Heavy Valves are tested to 800 pounds hydraulic pressure. The factor of safety is so high, however, that the test pressure can be increased to double this figure if required and the valves may be safely used on hydraulic or air pressures up to 800 pounds.

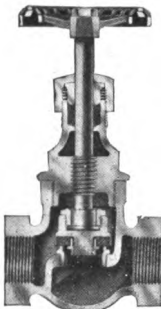


Fig. 128
Sectional view of
Brass Globe Valve
Extra Heavy Pattern



JENKINS BROS.

JENKINS BROS. EXTRA HEAVY AUTOMATIC EQUALIZING STOP AND QUICK VALVES

are designed to shut off, automatically, the flow of steam from the header to a boiler in case a tube should burst or other internal rupture occur, thereby suddenly reducing the pressure in the boiler. They also serve to equalize the pressure in a battery of boilers and prevent one boiler from working at a lower pressure than the others. As the valves can only be opened by the pressure in the boiler it is impossible to turn steam accidentally into a boiler which is being cleaned. To prevent chattering, the valve is cushioned by an internal dashpot made of bronze which eliminated all danger of sticking through corrosion.

Each valve is carefully tested to 800 pounds hydraulic pressure and is guaranteed for working steam pressures up to 250 pounds. The stuffing-boxes can be packed when valve is wide open under full pressure.

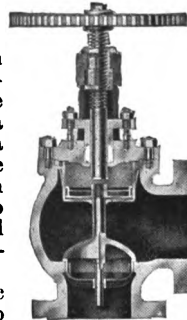


Fig. 293
Sectional View of Automatic Stop and Check Valve, Angle Pattern

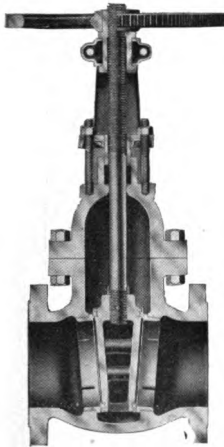


Fig. 245
Sectional View of Extra Heavy Iron Body Gate with Outside Screw and Yoke

JENKINS BROS. GATE VALVES

are a comparatively new, and distinctly high grade line. They are made in brass or iron body in three distinct patterns: Standard, for 125 pounds working steam pressure, or 175 pounds water; Medium, for 175 pounds steam or 250 pounds water; Extra Heavy, for 250 pounds steam or 400 pounds water.

They are all of the solid-wedge, double-face type. The wedge or gate is guided by ribs cast on the inside of the body, which fit in corresponding channels in the wedges, thereby preventing the wedge from dragging across the seat, preventing uneven wear on the faces, or chattering when valve is partly open.

One of the important features of these valves is the improved globe shaped body, a novel design which is used because it secures the greatest possible strength, good proportion and neat appearance.

The brass valves are regularly made in sizes $\frac{1}{4}$ to 3 inches. Larger sizes in brass can be made from iron body patterns.

Standard Iron Body Valves made in sizes 2 to 30 inches; Medium up to 18 inches; Extra Heavy up to 24 inches.

JENKINS BROS. CAST STEEL VALVES

are made in Globe, Angle, Gate and Check Patterns, which experience has shown are perfectly adapted for the severe conditions incident to high pressure superheated steam service. The steel used in these valves is made in a modern converter from selected irons and for strength, ductility and soundness the castings are fully equal to those produced commercially by any known process.

For seat-rings, discs, bushings, and spindles Monel Metal is used, a natural alloy containing about 70 per cent nickel. The tensile strength is high, it is very hard, durable and non-corrosive and expands and contracts practically the same as cast steel. Seat-rings made of this metal do not get loose under the most severe conditions.

The valves are suitable for working steam pressures up to 350 pounds, and total temperature of 800° F.

All the genuine Jenkins Bros. Valves bear the Diamond Trade Mark, and are absolutely guaranteed to be perfect in workmanship and suitable and efficient in the service for which they are designed.

A catalogue of all the Jenkins Bros. products, giving sizes, styles and list prices mailed on request.

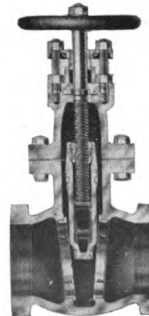


Fig. 250
Sectional View of Iron Body Gate, Inside Screw



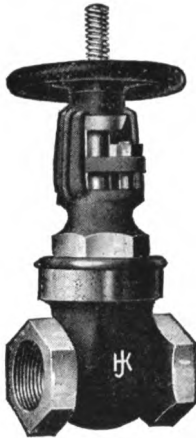
THE KELLY & JONES CO.

GREENSBURG, PA.

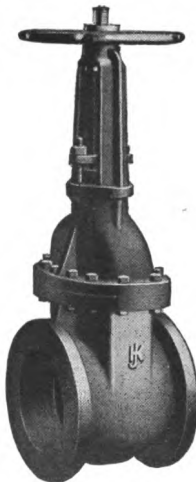
MANUFACTURERS OF BRASS AND IRON PIPE FITTINGS, BRASS AND IRON VALVES, COCKS, ETC. FOR STEAM, GAS, WATER, AIR AND OIL



Reducing Flanged Tee



Brass Gate Valve



Iron Body Gate Valve

FLANGED FITTINGS

We make a Flanged Fitting for every pressure and purpose, Brass or Iron, and in all sizes, straight or reducing. Drilling in accordance with the latest established standards.

BRASS GATE VALVES

Our line of Brass Gate Valves is most complete. Correctly designed and well proportioned and can be furnished screwed or flanged for the following pressures: 100 lbs., 125, 150, 175, 200, 250, 500 and 1000 lbs.

The OS&Y Gate Valve illustrated is designed to meet the requirements of the Underwriters and can be supplied for either 125 or 150 lbs. pressure.

"EXCELSIOR" BRASS VALVES

For High Pressure service, 200 or 300 lbs. of live or superheated steam. Used extensively in modern steam plant construction and in the U. S. Navy. Can be furnished with or without Yoke, Screwed or Flanged, Globe, Angle, Cross and Check. Sizes from $\frac{1}{8}$ " to 4".

IRON BODY VALVES

All styles and sizes for all pressures and purposes including Globe, Angle, Cross, Check and Safety Valves, Gate Valves, Blow-Off Valves, Pressure Regulating Valves, etc.

Our IRON BODY GATE VALVES can be furnished Screwed or Flanged, with or without Yoke and By-Pass and for 25, 125, 175, 250 and 1000 lbs. pressure.

K&J BLOW-OFF VALVES, Globe or Angle, Screwed or Flanged have been in satisfactory use for years.

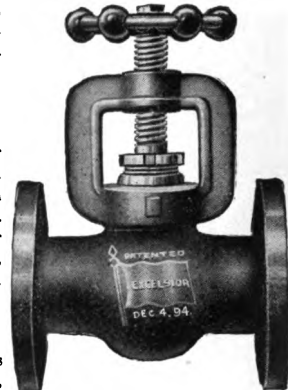
AUTOMATIC STOP CHECK VALVES

These Valves should be included in the equipment of every steam plant having more than one boiler. Close automatically and instantly, cutting out the boiler to which they are connected. In case of a blow out, this Valve will act immediately as a non-return Valve and prevents back flow of steam from the main. Can be furnished Globe or Angle, Screwed or

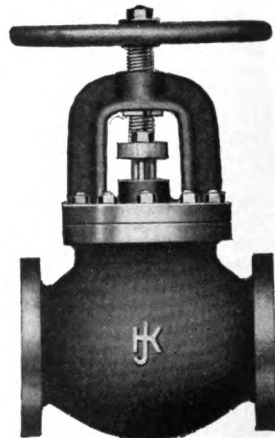
Flanged in all sizes.



Flanged Elbow



"Excelsior" Brass Valve



Automatic Check Stop Valve

THE KENNEDY VALVE MFG. CO.

Main Office and Works

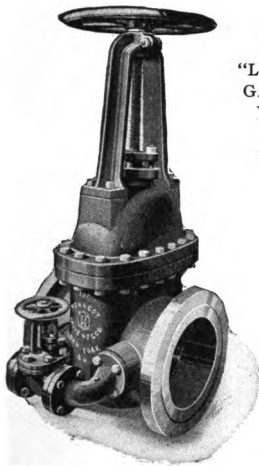
1100 E. WATER ST., ELMIRA, N. Y.

AGENCIES

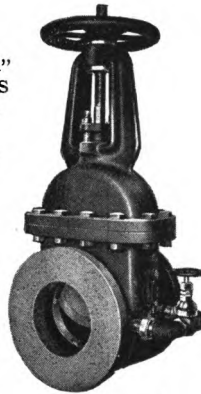
57 Beekman St., New York City 602 Western Union Bldg., Chicago
415 French Savings Bank Bldg., San Francisco 604 Canal-Louisiana Bank Bldg., New Orleans

GATE, GLOBE, ANGLE, CHECK, RADIATOR AND INDICATOR VALVES
For Power, Heating, Fire Protection, Water Supply, etc.

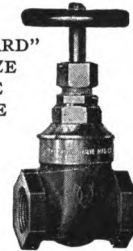
FIRE HYDRANTS



**HEAVY
"LENTICULAR"
GATE VALVES**
With Double
Discs,
Taper Seats

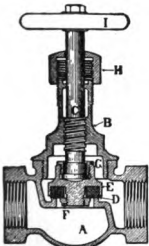


**"STANDARD"
BRONZE
GATE
VALVE**

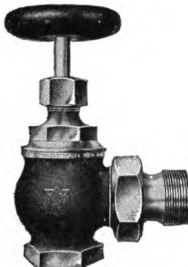


Screwed

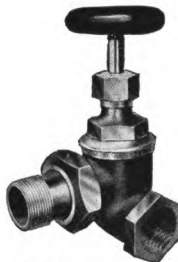
GLOBE, ANGLE, RADIATOR AND CORNER VALVES With Renewable Disc



Sectional View
Globe Valve



Angle Type

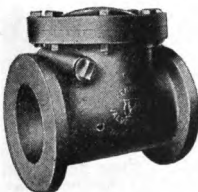


Offset Corner Type

SWINGING CHECK VALVES

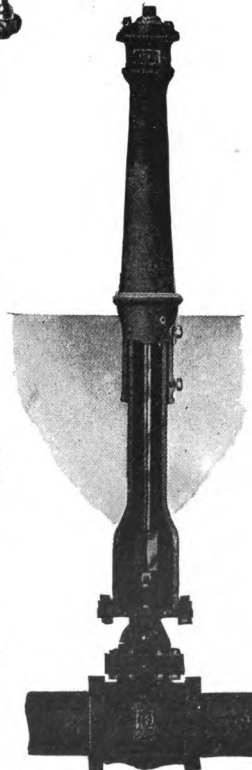


Bronze



Iron Body
Bronze Mounted

Write for recently
issued catalogue
describing all the
above and many
other kinds of
valves.



Indicator Post Valve

J. E. LONERGAN CO.

211-215 RACE ST., PHILADELPHIA, PA.

MANUFACTURERS OF BOILER, STEAM & GAS ENGINE SPECIALTIES



POP SAFETY VALVES

Were first made under Lynde Patents issued in the year 1872, and have since been improved upon by our corps of capable engineers of long experience, who with their combined skill have brought the LONERGAN POP SAFETY VALVE up to its present state of excellence.

Points of superiority:

1. Does perfect work while in service.
2. Repairs practically nothing.
3. Has long life.
4. Always seats perfectly.
5. *Great relieving capacity* as it is the only valve on the market having an expansion chamber above the seat, with baffle plate over that, so as to get the benefit, as the steam lifts the valve off its seat, of both the compressed and expanded steam, which construction gives the valve a high lift.
6. *Adjustable screw ring*, very easy to regulate—used to govern number of pounds steam relieved before valve closes.
7. Springs of the best grade PENNSYLVANIA ANALYSIS OPEN HEARTH STEEL, of a fibre stress suited for best results.
8. All valves made with bevel seats, except when otherwise ordered.

"Protected Spring" Pop Safety Valve

For Water Tube Boilers, etc.



Model "B"

Encased Spring, to protect it from contact with live steam.

LonerGAN Patent Double Eccentric Lifting gear, the best lifting device made.

Good for working pressure up to 300 lb.

Testing yokes furnished at small extra charge.

Fitted for LOCK to prevent their being tampered with.

Recommended for use in Power Stations, Electric Light Plants, Large Manufacturing Plants.

Sizes 2", 2½", 3", 3½", 4", 4½", 5" and 6", Iron Body
Bronze Mounted, with either bronze or nickel seats.

"Marine" Pop Safety Valve

For use on Marine Boilers.

General Specifications same as Model "B"

Handle on top allows valve to be turned on its seat when under steam pressure.

Repairs easily made as valve can be broken below outlet, for seat repairs.

Complies with rules of:

United States Board of Supervising Inspectors of Steam Vessels.

Board of Trade, Great Britain.

British Lloyds.

Bureau of Veritas, France.

Sizes 2", 2½", 3", 3½", 4", 4½", 5" and 6". Iron Body
Bronze Mounted.



Model "D"

WATER RELIEF VALVES: Good for working pressures up to 300 lbs. Recommended for use on Pumps, Hydraulic Elevators, Pipe Lines, Water Works, etc. Relieving capacity unequalled by any other make of valve on the market.

We also manufacture Cylinder Relief Valves, Chime Whistles, Plain Whistles, Quick Closing Water Gauges, Automatic Closing Water Gauges, Chain Pull Gauge Cocks, Oil Cups, Grease Cups, Jelco G. G. Cutters.

McNAB & HARLIN MFG. CO.

EXECUTIVE OFFICES, 55 JOHN STREET, NEW YORK CITY

Established 1854

Factory, PATERSON, N. J.

**BRASS, IRON AND STEEL FITTINGS, VALVES, COCKS, PIPE, ETC.,
FOR STEAM, WATER AND GAS**



C. I. Fitting

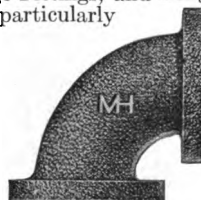
CAST IRON FITTINGS—SCREWED

"MH" Fittings are made of the best quality grey iron and threaded to Briggs Standard Gauge. We have a complete line of patterns for all styles, in both Standard and Extra Heavy.

In addition to our full line of steam fittings, we have a complete line of patterns for Drainage Fittings, and Long Turn Fittings, screwed and flanged, particularly adapted to Sprinkler Work.

CAST IRON FITTINGS—FLANGED

We carry a very large and complete stock of both Standard and High-Pressure Flanged Fittings, in all styles and sizes, and are in a position to furnish these goods, which are designed for high grade power plant installation, on very short notice.



C. I. Flanged Fitting



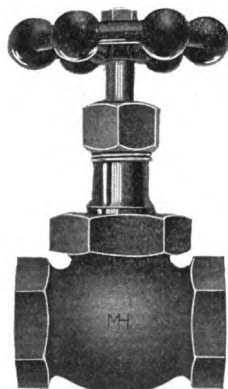
Brass Fitting
Malleable Pattern

BRASS FITTINGS

"MH" Brass Fittings are made from a standard composition, best suited for this class of work. Having a complete line of patterns for both Flanged and Screwed, we are in a position to furnish these Fittings from the Malleable and the Cast Iron patterns very promptly.

JENKINS DISC STEAM METAL VALVES

In addition to our full line of Hard-seat Valves, we have a full line of patterns for Jenkins Disc Steam Metal Valves: Globe, Angle, Horizontal, Vertical and Angle Check Valves. All parts of these Valves are interchangeable with Jenkins Bros. Valves. These Valves regularly are furnished with the composition discs, but can be furnished with special soft-rubber discs for Air and Cold Water, or with a metallic disc when conditions require same.



Regrinding Valve



Jenkins Disc
Brass Valve

"MH" REGRINDING VALVES

We solicit your inquiries for a trial order for "MH" Regrinding Valves. These Valves are made of a very high quality Steam Metal, selected after careful study and chemical and physical tests, to give the most satisfactory service. We have patterns for a complete line of these Valves, which are good for 200 pounds steam pressure and are all thoroughly tested before leaving our factory. We recommend them to give perfect satisfaction where conditions require a Valve of superior quality.

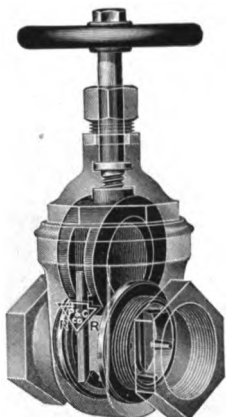
STEEL VALVES AND FITTINGS

To meet the requirements of the Engineering Trade, we have added to our extensive line of high grade "MH" goods, Steel Valves and Fittings, that are especially adapted for power plant and superheated steam work.

PRATT AND CADY CO., INC.

HARTFORD, CONN.

VALVES, COCKS AND HYDRANTS



Renewable Seat Gate Valve

RENEWABLE SEAT GATE VALVES

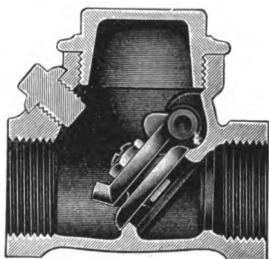
Brass and Iron

All styles for all pressures. Sizes up to 24 inches. With renewable seat rings, held in place by separate retaining rings easily removable.

The seat rings are independent rings of bronze, or any special metal or material best adapted for the service in which the valve is to be used. The gate is a double faced, wedge shaped casting, with side grooves by means of which it slides on guides in the valve body.

Gauges are used in machining all parts to insure their accuracy and interchangeability.

The guides in the bodies are of equal thickness, and the wedge can be taken out of the valve and replaced with the opposite faces in contact, and will give an accurate fit. The importance of this in making repairs is obvious. These valves being double seated, can be used with the pressure applied at either end.



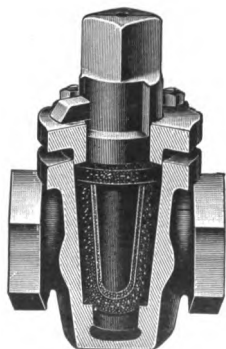
Regrinding Swing Check Valve

REGROUNDING SWING CHECK VALVES

Brass and Iron

All styles for all pressures, sizes up to 36 inches.

The design combines pressure resistance with easy flow lines. Material (of brass valves) is 86% pure copper. Each valve is tested to an adequate pressure. All seats are carefully ground. Assembling is done by expert mechanics. The interior construction permits the replacement of any working part without removing valve from line. For regrinding no tool is necessary but a wrench and brace and bit.



Asbestos-Packed Cock

ASBESTOS-PACKED COCKS

Brass and Iron

Made in sizes $\frac{1}{8}$ inch to 8 inches, for all pressures.

The dovetailed, U-shaped grooves in the body are packed with prepared asbestos. An asbestos ring is used on the shoulder of the plug for top packing.

The plug is of standard taper carefully finished and barfed to render it rustless. It has no metallic bearing, coming in contact only with asbestos, the elasticity of which compensates for the differential expansion and contraction of the plug and body. The gland admits of adjustment by means of its bolts.

These cocks give exceedingly satisfactory results as boiler blow-offs and water column blow-offs, between check and boiler, between water column and boiler, and they do work where ground plug cocks, globe, angle or gate valves fail.

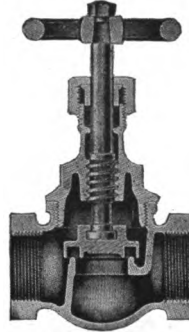
PRATT AND CADY CO., INC.

ASBESTOS DISC GLOBE AND ANGLE VALVES

Made in sizes $\frac{1}{8}$ inch to 3 inches for 150 lbs. pressure. The stuffing box gland is long, heavy and well fitted. The spindle collar, and its point of contact with the bonnet, have specially smooth surfaces and make a steam-tight joint when valve is fully open.

The disc holder is guided by four splines in the body, assuring perfect alignment at all times. The disc holder is of the horseshoe type, and can be removed and replaced, the only tool necessary therefor being a wrench to unscrew the bonnet.

The seat is spherical, thus preventing the settling thereon of any substance that might hold the disc from going squarely to its place. The bronze in these valves is approximately 86% pure copper.



Asbestos Disc Globe Valve

CAST STEEL GATE VALVES FOR SUPER-HEATED STEAM

All tested to a hydrostatic pressure of 800 lbs., suitable for 250 lbs. pressure and 200 degrees superheat.

All valves $2\frac{1}{2}$ " to 6" are equipped with cast steel bodies, bonnets, yokes and nickel-bronze wedges.

Valves 7 inches to 16 inches have cast steel wedges.

The seats and faces of the wedges are made of nickel-bronze, securely fastened in place so that they cannot work loose.

Stems are cold rolled steel.

All bolt holes are spot faced.

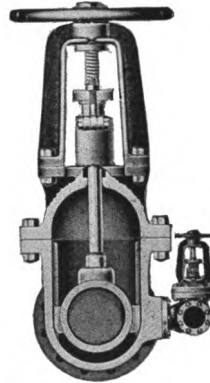
Bonnet joint is packed with the best grade of superheat packing.

The end flanges have $\frac{1}{8}$ " raised faces, extending full width inside of bolt holes, with smooth finish.

All bolts have hexagon heads and nuts, with their under sides semi-finished.

The discs can be furnished either split or solid wedge pattern.

Stuffing box is made with hinge bolts, very deep for square packing.



Cast Steel Gate Valve

AUTOMATIC NOISELESS STOP AND CHECK VALVES

Made in iron body in sizes 2" to 10" from both globe and angle patterns, with either screwed or flanged ends for pressures up to 250 pounds to the square inch.

For use between the main steam header and each boiler of a battery.

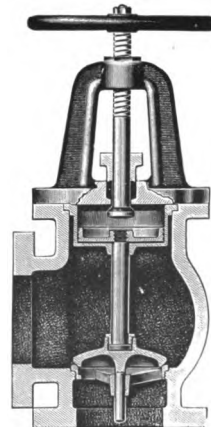
Closes automatically if the boiler pressure should be reduced through any cause.

Acts as an equalizing valve between the units of a battery, remaining closed until the boiler pressure reaches the same degree as that in the header.

Can be used as a positive stop valve by using the hand wheel to force the disc to its seat.

The internal dash-pot, the piston, and the disc are made of bronze to prevent corrosion.

If required for controlling superheated steam, these valves can be furnished in cast steel with nickel-bronze working parts. When so made, they are suitable for pressures up to 250 pounds and total temperatures not exceeding 800 degrees Fahrenheit.



Automatic Noiseless Stop and Check Valve

ROE STEPHENS MFG. CO.

DETROIT, MICH.

**MANUFACTURERS OF SCOTT'S HIGH GRADE VALVES for Steam, Water,
Air and Gas**

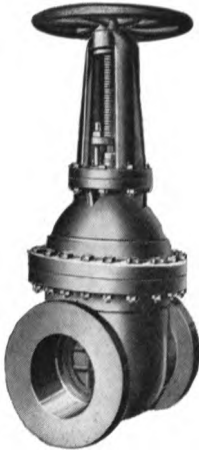
VALVES

All Kinds and for All

Pressures

Straightway Gate, Globe,
Angle, Swing Check, Throttle,
Hot Water and Steam Radi-
ator, Pop Safety and Relief,
Back Pressure and Exhaust
Relief.

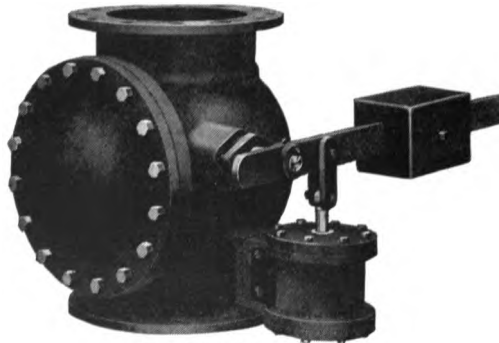
Also Fire Hydrants and
Water Works Valves.



Scott Gate Valve with
Outside Screw and
Yoke



Scott Gate Valve with
Stationary Stem



Scott Back Pressure Valve

We make a full line of Valves of both the Celebrated "Scott" or "Michigan" patterns.

Send for our Catalogue and look over our Complete Line.

We have made Valves as small as $\frac{1}{8}$ of an inch and as large as 120 inches. So we should be able to furnish anything wanted in the Valve line.

KENNEDY-STROH CORPORATION

PITTSBURGH, PA.

BRANCH OFFICES: NEW YORK PHILADELPHIA CHICAGO

MANUFACTURERS AND ERECTORS OF MATERIALS FOR STEAM, AIR AND HYDRAULIC PIPING SYSTEMS: VALVES, FITTINGS, FLANGES, FLEXIBLE JOINTS, EXPANSION JOINTS OF VARIOUS TYPES, PIPE BENDS, FABRICATED PIPE, VANSTONE JOINTS, WELDED HEADERS, GULLAND AUTOMATIC VALVES AND WATER COLUMNS, ETC.

PIPING FOR POWER HOUSE, MINE, MILL, ETC.

We are prepared to furnish pipe bends of any size pipe obtainable, either in wrought iron, steel, brass or copper, in any possible contour. We flange straight and bent pipe in any approved manner, i.e., Threaded, Shrunk Vanstone or Welded.



Welded Steel Header

For the purpose of reducing the number of flanged joints to a minimum, we weld either seamless forged steel necks or vanstone necks onto the pipe, thus producing our Welded Steel Header. The Headers of this type which we have furnished have, without exception, given the utmost satisfaction in service.

IRON CASTINGS: Our foundry facilities enable us to make castings in weights up to 50 tons. Particularly well equipped for furnishing special castings required in connection with turbine installations.

FLANGED FITTINGS: Our line of flanged fittings and flanges is complete from Low Pressure to Heavy Hydraulic, made of metals suitable for the different services. All of our flanged fittings conform to the "American Standard."

VALVES: Our line of Valves, embracing the following types, viz., Gate, Globe, Angle, Back Pressure, Exhaust Relief, and Combination Back Pressure and Exhaust Relief, is complete in all suitable metals and weights for the various services. We supply valves with any desired operating device, i.e., Hand or Chain Wheel, Bevel Gear, Spur Gear, Hydraulic Cylinder or Motor Drive.

"Best" Low Pressure and Standard Valves are furnished with double discs and parallel seats.

"Best" Extra Heavy, Superheat, and Extra Heavy Hydraulic Valves are furnished with the device herewith illustrated, i.e., *STEM AND DISC HOLDER IN ONE PIECE WITHOUT JOINT WITH DOUBLE DISCS MADE ADJUSTABLE IN ANY PLANE BY BALL AND SOCKET JOINT ON BACK.*

"Best" Cast Steel Valves for Superheated Steam are built with Monel Metal Trimmings and with the One Piece Stem and Disc Holder, above described, of Monel Metal. These valves are designed and built for working pressures up to 350 lbs., with temperatures up to 800° Fahr.

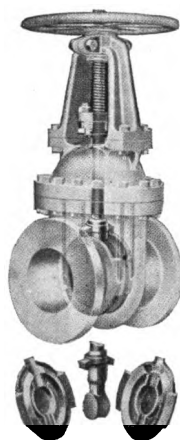
"Best" Low Pressure Gate Valves with Back Outlets are designed for service between turbine and condenser. We build these valves in sizes from 12" up to any desired dimension.

We build special valves for hydroelectric and irrigation projects.

Ask for our catalogue, also for our "Model Piping Specifications."



Low Pressure Gate Valve with Back Outlet



Superheat Valve

PITTSBURGH VALVE, FOUNDRY & CONSTRUCTION CO.

PITTSBURGH, PA.

ENGINEERS, MANUFACTURERS AND ERECTORS

BRANCH OFFICES AND AGENTS

New York Office, 30 Church Street.

Cleveland Office, 978 Rockefeller Bldg.

Birmingham, Ala., Young & Vann Supply Co.,
1809 First Avenue.

Bisbee, Ariz., Carl Clausen Engineering Office.

Bluefield, W. Va., Stephen H. Meem & Co.

Chicago, Ill., W. L. Buss, 1215 Marquette Bldg.

Philadelphia, Pa., Charles H. Whitney & Co.,
Harrison Bldg.

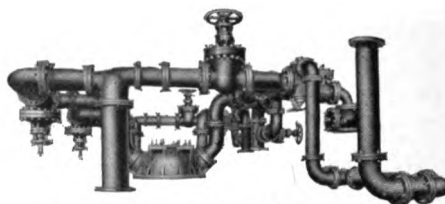
Salt Lake City, Utah, Utah Engineering &
Machinery Co.

San Francisco, Cal., E. A. Keithley, Rialto
Bldg.

Toronto, Ont., W. M. Campbell, 25 Howland
Avenue.

VALVES, FITTINGS AND APPLIANCES of Every Description for Steam, Gas, Water, Air and Hydraulic Piping

Complete piping contracts executed—designed by experienced engineers, manufactured by skilled workmen under intelligent supervision and erected by expert fitters.



Piping for Panama Canal Chain Fender Pits

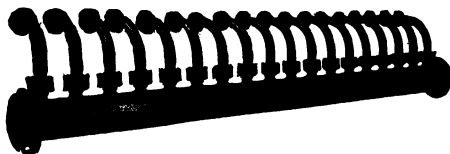


6'-0" x 6'-6"
Sluice Gate

Special Valves and Sluice Gates for hydraulic installations, Motor Operated and Cylinder Operated. Hydraulic Operating Valves for blast furnace doors and bells, and for steel mill tables and rolls.

Special facilities for casting and machining large pipe, fittings, furnace castings, etc.

Pipe cutting, bending and welding. Branches and manifold outlets fabricated by the patented Interlock Method.



16" Welded Header with 18-4" Branches

PITTSBURGH VALVE, FOUNDRY & CONSTRUCTION CO.

STANDARD LINES OF GATE VALVES

SPECIFICATIONS FOR MATERIAL Grey Iron—22,000 lb. per sq. in. tensile strength.

Semi Steel—33,000 lb. per sq. in. tensile strength.

PARALLEL SEAT 50 lb. WORKING PRESSURE 100 lb. TEST PRESSURE Sizes 14" to 72" cast iron. Low pressure. For water, gas, air or exhaust steam. Extremely close face to face, invaluable in complicated piping connections.

PARALLEL SEAT 125 lb. WORKING PRESSURE 300 lb. TEST PRESSURE Sizes 2" to 48" cast iron. Standard pressure. For water, air, steam or gas. Fully bronze mounted. Especially adapted to water distribution.

PARALLEL SEAT 200 lb. WORKING PRESSURE 400 lb. TEST PRESSURE Sizes 1½" to 16" cast iron. Largely used for natural gas under the lower pressures. Furnished either all iron or iron body bronze mounted.

PARALLEL SEAT 400 lb. WORKING PRESSURE 800 lb. TEST PRESSURE Sizes 3" to 20" semi steel. In extensive use for the transmission of natural gas. Furnished either with or without bronze mountings.

PARALLEL SEAT 500 lb. WORKING PRESSURE 1500 lb. TEST PRESSURE Sizes 2" to 12". For water or oil at pressure noted. Semi steel with solid bronze mountings.

PARALLEL SEAT 1000 lb. WORKING PRESSURE 1500 lb. TEST PRESSURE Sizes 2" to 12" semi steel. High pressure gas valve used chiefly at the gas wells and on feeders in the gas fields.

PARALLEL SEAT 1500 lb. WORKING PRESSURE 2000 lb. TEST PRESSURE Sizes 2" to 10" semi steel. For hydraulic service and extreme natural gas rock pressures.

TAPER SEAT 175 lb. WORKING PRESSURE 500 lb. TEST PRESSURE Sizes 2" to 16" semi steel. A valve for medium steam pressures from 125 lb. to 175 lb. where a less expensive valve than the 250 lb. type is desired.

TAPER SEAT 250 lb. WORKING PRESSURE 800 lb. TEST PRESSURE Sizes 1½" to 28" of semi steel with solid bronze mountings for ordinary steam pressures. Sizes 2" to 24" for superheat steam up to a temperature of 500 degrees Fahrenheit of cast-steel with full monel mountings, monel stems and cooling chamber to protect packing.

TAPER SEAT 1000 lb. WORKING PRESSURE 2000 lb. TEST PRESSURE Sizes 2" to 10". The strongest valve possible to make in its weight, all surfaces being cylindrical or spherical segments.

GATE VALVES FOR ANY PRESSURE Designs and quotations furnished for valves for special conditions or higher pressures. Materials used are those best adapted to service.



50 lb. Parallel Seat Gate Valve. Close Pattern



14" Cast-Steel Gate Valve for Superheat Steam



4" 1000 lb. Gas Line Gate Valve



8" 1000 lb. Hydraulic Gate Valve

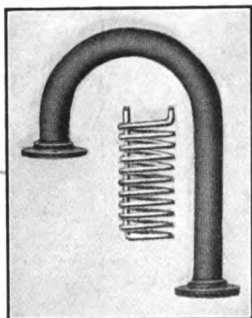
JOHN SIMMONS CO.

110 CENTRE ST., NEW YORK

IRON PIPE, FITTINGS AND VALVES



"Jarecki" Cast Iron Fittings



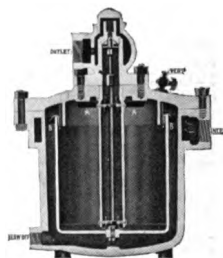
Simmons' Pipe Bends and Coils



Simmons' Gate Valve for
Superheated Steam



Simmons' Blowoff Valve



Stickie Steam Trap

In our New York City plant, in addition to a large and varied stock of material for STEAM ENGINEERING, including WROUGHT IRON and WROUGHT STEEL PIPE $\frac{1}{8}$ " to 18" inclusive, we have a pipe cutting department with forty machines, cutting up to and including 18" and a fully equipped machine shop for all work connected with Steam Engineering.

We make continuous welded pipe coils, spiral, flat, round and return. Also return bend coils, made of standard or extra heavy pipe and fittings.

Bends of Wrought Iron Pipe $\frac{1}{8}$ " to 24" in diameter, standard and extra heavy, made in all shapes and for all purposes. Also brass pipe bends.

Fittings, standard weight and extra heavy, cast iron, malleable iron and semi-steel of regular and special design, high and low pressure, screwed and flanged joints.

We carry in stock and make to order, all Standard Styles and Sizes of Valves, including globe, angle, cross, check and foot valves, made of brass, bronze, iron, and special alloy metals for acid work, all with screwed or flanged ends. Gate Valves in standard and special designs, for ordinary and extreme working pressure. Rothchild Blow-off Cock or Rotary Gate Valves.

CENTRAL FOUNDRY COMPANY

90 WEST STREET, NEW YORK

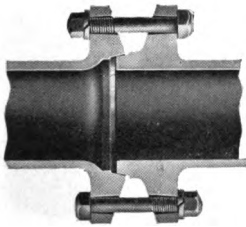
CHICAGO

ATLANTA

SAN FRANCISCO

DALLAS

SOIL PIPE, UNIVERSAL PIPE, F. & W. FITTINGS, GENERAL CASTINGS



Sectional View of Pipe

UNIVERSAL PIPE

Universal Pipe is cast iron pipe with hub and spigot ends, the contact surfaces of which are machined on a taper giving a natural iron to iron joint, which is permanently tight. By making the tapers of slightly different pitch the joint provides for expansion and contraction, vibration and uneven ground settlement.



Trade Mark

The lengths of pipe are drawn together by bolts, two bolts to a joint sufficing except for pressures above 175 pounds. The pipe can therefore be laid at a slight labor cost, and without caulking. No molten lead, oakum, etc., required. No equipment, except two wrenches.

The iron to iron contact of the Universal joint eliminates electrolysis. The result is a pipe that *does not leak, and continues not to leak*, with a joint that as long as cast iron lasts, will remain tight under pressures even up to 500 pounds.

High Pressure Service: Universal Pipe is especially adapted to high pressure service, and particularly for high pressure fire lines. There is no packing to blow out, and nothing to deteriorate.

Subaqueous Work: Lines running under rivers or under water work of any kind are easily and economically laid by the use of Universal Pipe. In shallow water the joints can be made up under water if convenient.

Gas Systems: Universal Pipe is particularly advantageous in high and low-pressure gas lines, by reason of the tight joint under differences of temperature and its freedom from electrolysis. The close contact of the smooth machined hub and spigot ends makes a joint through which gas cannot escape.

Curved Lines: Straight lengths of Universal pipe may be laid on a curve of 150 feet radius.

SPECIFICATIONS

Nominal Inside Diameter	Class No. 100 100 Lbs. Pressure			Class No. 130 130 Lbs. Pressure			Class No. 175 175 Lbs. Pressure			Class No. 250 250 Lbs. Pressure			Bolt Sizes
	Approx. Thickness Inches	Estimated Weight Pounds per		Approx. Thickness Inches	Estimated Weight Pounds per		Approx. Thickness Inches	Estimated Weight Pounds per		Approx. Thickness Inches	Estimated Weight Pounds per		
		Foot	6-Foot Length		Foot	6-Foot Length		Foot	6-Foot Length		Foot	6-Foot Length	
2	.....	.....	.....	.....	.....	.....	.35	8½	51	.39	9½	57	½ x 3½
3	.....	.....	.....	.....	.....	.....	.37	13	78	.42	14½	87	½ x 4
4	.37	18	108	.40	18½	112½	.43	20½	121½	.45	21½	127½	½ x 5
5	.40	24	144	.425	25	150	.45	26	156	.49	29	174	½ x 5½
6	.43	30	180	.45	31	186	.47	32	192	.51	35½	213	½ x 6
8	.47	44½	265½	.49	46	276	.525	49½	295½	.58	53½	319½	½ x 6½
10	.50	60½	363	.53	63½	381	.58	67½	406½	.64	74	444	1 x 7½
12	.53	75½	453	.57	80½	483	.62	87	522	.70	97½	585	1 x 8
14	.565	94½	567	.60	99½	597	.66	107½	645	.76	124	741	1½ x 9
16	.60	115½	693	.65	123	738	.72	134	804	.83	156	936	1½ x 9½
20	.67	166	996	.73	178	1068	.82	196	1176	.94	223	1338	1½ x 11½

Lengths lay a full six feet. All pipe tested with a minimum hydrostatic pressure of 300 pound per square inch.

Special Castings are made with Universal hub and spigot openings, thus avoiding, except in extreme cases, the use of nipples. The lugs upon special castings are in one plane so that the branches or openings will all be in the same plane.

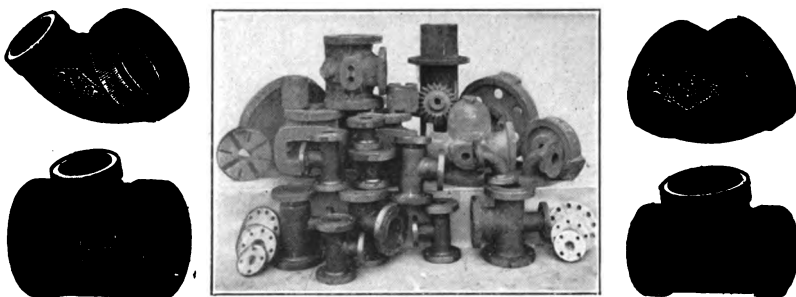


MALLEABLE IRON FITTINGS CO.

INCORPORATED 1864

BRANFORD, CONN.

MANUFACTURERS OF MALLEABLE IRON PIPE FITTINGS for Gas, Steam and Water; STEEL FITTINGS for High Pressure Service; AIR FURNACE REFINED MALLEABLE IRON AND SEMI-STEEL CASTINGS; CARBON AND ALLOY STEEL CASTINGS



EXTRA HEAVY FLANGES

For High Pressure Requirements

For Rolled, Shrunk or Welded Connection, bored, countersunk, grooved, faced and drilled to specification.

HIGH PRESSURE FITTINGS

Standard Sizes in Stock in Steel or Malleable

Machined, tested and ready for the line.

Specials made to order for railroad, manufacturing, mining, and municipal power plants in compliance with Lloyds Rules or Regulations of the U. S. Steamboat Inspection Service.

MALLEABLE IRON AND SEMI-STEEL CASTINGS

For Machinery; Automobile; Gun; Sewing-Machine; Overhead, Third-Rail, Underground Electrical Construction and all miscellaneous work.

LOW CARBON STEEL CASTINGS

Better than Open Hearth—Equal to Crucible

SPECIAL METAL "A"

For Gears and Cams where resistance is wanted. May be heat treated to required hardness.

AIR FURNACE REFINED VANADIUM IRON

For Piston Heads, Piston Rings, and Cylinders. Has a high tensility and is tough, sound, and dense.

CUSTOM AND JOBBING DEPARTMENT

Galvanizing, Tinning, Japanning, Contract Machining of Malleable Iron, Grey Iron, Wrought Iron, and Steel. Galvanized Nails—Marine Hardware.

TIGHT JOINT COMPANY

306-310 EAST 47TH ST., NEW YORK

MANUFACTURERS OF HIGH PRESSURE PIPE FITTINGS

TIGHT JOINT FITTINGS AND FLANGES

(Folly's Patent)

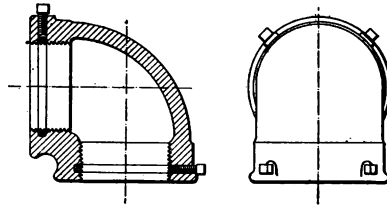
Extra and Double Extra Heavy High Pressures

The "Tight Joint" itself will be readily understood from Figure 1, and the following description:

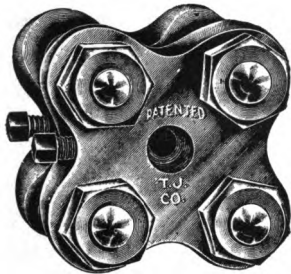
The pipe is screwed into the fitting as in the case of ordinary low pressure work, and does not butt against a shoulder. The lead joint or thread, extends slightly beyond the threads of fitting. If a pipe is screwed into the fitting it will expand the lead packing, causing it to tightly fill the screw threads, and if the joint is not made tight by this means, one or more turns of the compressed screw will crowd the lead around the pipe and make it absolutely and permanently tight.

It will be seen that as long as the end of the pipe projects a quarter of an inch beyond the lead collar a perfect joint can be assured, but the end of the pipe may be carried as much as $\frac{3}{4}$ of an inch beyond this point. In this way a considerable latitude is possible and erection made very easy.

That the working of a large hydraulic system during an extended period has no effect upon the joint has been proved by its use in High Pressure Hydraulic Elevators, Hydraulic Riveters, Presses, General Hydraulic Systems, High Pressure Steam, 3000 lbs. per square inch Air Pressure and a very extended use in all classes of Ammonia Work.



(1) Sectional Cut of Fitting



Tight Joint Flange Union

The flange unions are furnished complete with bolts and T. J. lead gaskets.

We carry in stock Elbows from $\frac{1}{4}$ " to 6" nominal inside diameter for 1000 lbs. working pressure, $\frac{1}{4}$ " to 3" diameter for 1500 and 3000 lbs. Couplings from $\frac{1}{4}$ " to 6" diameter for 1000 lbs., $\frac{1}{4}$ " to 3" for 1500 and 3000 lbs. Crosses from $\frac{1}{4}$ " to 2" diameter for 1000, 1500 and 3000 lbs. Tees from $\frac{1}{4}$ " to 6" diameter for 1000 lbs., $\frac{1}{4}$ " to 3" diameter for 1500 and 3000 lbs. Flanges from $\frac{1}{4}$ " to 6" diameter for 1000 lbs., $\frac{1}{4}$ " to 4" diameter for 1500 lbs., $\frac{1}{4}$ " to 3" diameter for 3000 lbs.

We make Reducing Bushings and Plugs. The Reducing Bushings have the lead collar and set-screws the same as our regular fittings, and can be supplied to meet any desired changes in size.

All fittings and flanges are made of air furnace malleable iron and annealed material having a tensile strength of from fifty to sixty thousand pounds per square inch. Each fitting is subjected to a test pressure after they are made up and finished. Galvanized fittings furnished when required. Bronze fittings for all pressures made to order.

We make to order Flanges and Fittings to stand any desired pressure.

Tight Joint Extra Heavy Fittings and Flanges are especially adapted for use on ammonia, brine, steam, gas, hydraulic and vacuum systems, being subject to a test pressure of 1000 lbs. per square inch, and are good for a working pressure of 500 lbs.

Tight Joint Double Extra Heavy Fittings and Flanges are good for working pressures up to 5000 lbs., each one being tested to 50% in excess of the required working pressure.

AMERICAN DISTRICT STEAM CO.

GENERAL OFFICES AND WORKS
NORTH TONAWANDA, N. Y.

First Nat. Bank Bldg.
CHICAGO

West Street Bldg.
NEW YORK

Hoge Building
SEATTLE

**ENGINEERS AND CONTRACTORS; "CENTRAL STATION HEATING";
EXAMINATIONS AND REPORTS; STEAM SPECIALTIES**

CENTRAL STATION HEATING SYSTEMS

UTILIZING THE EXHAUST STEAM FROM ELECTRIC LIGHT AND POWER PLANTS FOR HEATING STORES, OFFICES, PUBLIC BUILDINGS, SCHOOLS, CHURCHES, RESIDENCES, ETC.

Our extensive experience dating back to 1877, enables us to closely foretell the possible income from the utilization of exhaust steam, if used according to the plans of the American District Steam Heating System. Hundreds of Central Stations are now operating over 1000 miles of underground mains with our system. In many cases, they have found that the income from the installations of the American System is often more than enough to pay all the expenses of generating current. We gladly send our engineers to investigate conditions, estimate the cost and tell what results can be expected.

98

STEAM SPECIALTIES

The following list gives the range of our activity in the manufacture of steam specialties and materials for underground pipe lines:—

Steam Pipe Casing	"Adsco" Receivers
Guides	"Adsco" Mercury Gauges
Single Expansion Variators	"Adsco" Water Gauges
Double Expansion Variators	"Adsco" Union Elbows
Standard Expansion Joints	"Adsco" Water Heaters
Iron Body Expansion Joints, Single and Double	Steam Meters, "pressure"
Flanged Anchor Specials	Ball Joints
Anchorage Fittings	Adjustable Annular Wedges
Special Flanged Fittings for Underground Steam Mains	Flanged 45° and 90° Angle Joints
Boosters	Steam Traps, high and low pressure
Standard Flanged Fittings	Oil and Water Separators
Reducing Companion Flanges	Back Pressure Valves
Companion Flanges	Cast Iron Valve Curbs
Long Sweep Cast Iron Fittings	Packingless Iron Body Gate Valves
Cast Iron Fittings	Iron Body Gate Valves
"Adsco" Graduated Radiator Valves	Radiator Valves
"Adsco" Damper Regulators	Condensation Meters
"Adsco" Relief Valves	Reducing Valves
	Wooden Water Pipe

Send today for our Bulletins and Catalogues—They are free and explain fully.

AMERICAN STEAM GAUGE & VALVE MANUFACTURING CO.

ESTABLISHED 1851

FACTORY AND GENERAL OFFICES, BOSTON, MASS.

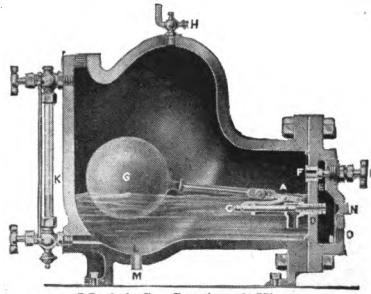
AMERICAN IDEAL STEAM TRAP

The essential feature of this Trap is its valve leverage, which is many times more powerful than in any other Float Trap. This permits the use of floats sufficiently heavy to prevent possibility of collapse, and we make positive guarantee to this effect when traps are used on pressures for which they are intended.

Special attention is called to the following table giving rated capacities for pressures 1 lb. to 30 lbs., this rating in every case being under rather than over what the trap will actually do.

We are also prepared to furnish rated capacities for pressures 30 lb. to 250 lbs. on application.

The features of construction of this trap, both as regards valve leverage and design of shell or casing, insure unusually low upkeep or maintenance, and absence of trouble in operation.



Model C—Sectional View

TABLE OF CAPACITIES—MODEL C—LOW PRESSURE

Size Trap		Pounds per Sq. Inch								
		3	5	8	10	13	15	20	25	30
No. 1 Trap ½ in. Opening	Gallons of water	405	525	670	755	860	925	1,065	1,185	1,300
	Pounds of water	3,380	4,380	5,600	6,320	7,180	7,730	8,880	9,900	10,880
	Lineal ft. of 1" pipe . .	6,000	7,780	9,950	11,220	12,750	13,720	15,780	17,600	19,300
	Sq. ft. of rad.	2,000	2,590	3,320	3,740	4,235	4,570	5,260	5,870	6,430
No. 2 Trap ¾ in. Opening	Gallons of water	610	795	1,004	1,120	1,287	1,380	1,580	1,770	1,950
	Pounds of water	5,100	6,640	8,380	9,360	10,750	11,550	13,200	14,800	16,300
	Lineal ft. of 1" pipe . .	9,050	11,600	14,900	16,650	19,100	20,500	23,470	26,300	29,000
	Sq. ft. of rad.	3,010	3,870	4,970	5,550	6,375	6,830	7,820	8,770	9,660
No. 3 Trap 1 in. Opening	Gallons of water	990	1,260	1,623	1,810	2,074	2,230	2,580	2,880	3,150
	Pounds of water	8,270	10,530	13,550	15,120	17,320	18,600	21,550	24,100	26,300
	Lineal ft. of 1" pipe . .	14,700	18,740	24,300	26,900	30,750	33,090	38,300	42,800	46,750
	Sq. ft. of rad.	4,900	6,250	8,100	8,970	10,250	11,000	12,770	14,260	15,580
No. 4 Trap 1¼ in. Opening	Gallons of water	1,520	1,940	2,490	2,800	3,190	3,440	3,970	4,420	4,850
	Pounds of water	12,700	16,200	20,800	23,400	26,650	28,700	33,150	36,900	40,500
	Lineal ft. of 1" pipe . .	22,600	28,800	36,900	41,650	47,300	51,000	59,000	65,650	72,000
	Sq. ft. of rad.	7,530	9,600	12,300	13,880	15,760	17,000	19,660	21,880	24,000
No. 5 Trap 1½ in. Opening	Gallons of water	2,140	2,800	3,530	3,970	4,525	4,870	5,620	6,270	6,850
	Pounds of water	17,750	23,400	29,500	33,150	37,800	40,700	47,000	52,300	57,250
	Lineal ft. of 1" pipe . .	31,550	41,650	52,400	59,000	67,150	72,700	83,500	93,000	102,000
	Sq. ft. of rad.	10,510	13,880	17,450	19,660	22,380	24,230	27,830	31,000	34,000

JULIAN D'ESTE COMPANY

24 CANAL ST., BOSTON, MASS.

BRASS FOUNDERS, FINISHERS AND MACHINISTS. SOLE MANUFACTURERS OF CURTIS ENGINEERING SPECIALTIES.



Damper Regulator

PRODUCTS: Damper Regulators, Improved Pressure Regulators, Improved Pump Regulators, Water Pressure Regulators, Expansion Trap, Return Steam Trap, Balanced Steam Trap, Relief Valve for Steam and Water, Steam Separator, Temperature Regulator, Pump Governor and Pump, Blower Valve, Cellar Drainer, U. S. Ball Cock, Etc.

THE CURTIS IMPROVED (PATENT) DAMPER REGULATORS

The plunger is operated by steam direct from the boiler, and the whole pressure in the boiler is therefore available to operate the damper if needed. In practice, only enough pressure is used to lift the weight, usually not more than ten pounds to the square inch on the plunger.

The motion of the damper will begin to change from one direction to the other on a variation of steam pressure of one half of a pound either way from the point at which it is set to operate.

We guarantee a saving of ten per cent of the fuel over the best hand regulation or the old style (diaphragm and lever regulator), and it often reaches fifteen per cent.

They are sent on thirty days' approval and will pay their cost by the saving of fuel in one year. Three Standard Sizes.

IMPROVED STEAM PRESSURE REGULATORS

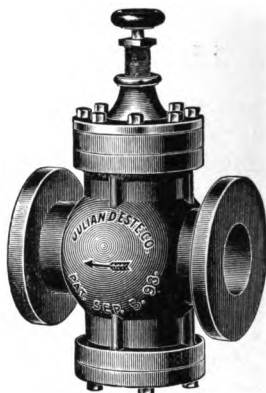
This regulator is made entirely of metal, occupies the same space as a globe valve for the same size pipe, and is very simple and sensitive.

By its use steam may be maintained at high pressure in boilers, and yet be reduced for heating to two or three pounds.

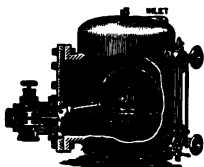
In the best engineering practice the exhaust steam of the engine and elevator is turned into the heating system of a building, and the Regulator automatically supplies just the amount lacking to maintain constant pressure in the pipes and radiators.

Standard sizes for $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3, 4, 5, 6, 7, 8, 10, 12, 14, and 16 inch pipe.

A lockup top furnished at small additional cost.



Steam Pressure Regulator



Balanced Steam Trap

THE CURTIS BALANCED STEAM TRAP

Some Points of Superiority

1. A perfectly balanced valve.
2. An absolutely frictionless valve.
3. The valve can be removed without breaking a joint, starting a gasket, or taking out a bolt.
4. The valve being frictionless and balanced, the whole power of the float is available for opening and closing it.
5. The copper float is perfectly spherical, as hermetically sealed as a glass globe, is of uniform thickness and warranted strong and tight at 250 lbs. pressure.

6. It has a pass-by valve to insure constant operation.

7. Each trap will operate perfectly on pressures varying from one to 250 pounds.

PRICE LIST

Size and Condensing Capacity in Feet of One-Inch Pipe

No. 000,	\$15.00 for	1,000 feet	$\frac{1}{2}$ in. inlet and outlet
No. 00,	20.00 for	2,000 feet	$\frac{1}{2}$ in. inlet and outlet
No. 0,	25.00 for	3,000 feet	$\frac{1}{2}$ in. inlet and outlet
No. 1,	30.00 for	5,000 feet	$\frac{3}{4}$ in. inlet and outlet
No. 2,	40.00 for	8,000 feet	1 in. inlet and outlet
No. $2\frac{1}{2}$,	55.00 for	15,000 feet	$1\frac{1}{4}$ in. inlet and outlet
No. 3,	75.00 for	30,000 feet	$1\frac{1}{2}$ in. inlet and outlet
No. 4,	100.00 for	40,000 feet	2 in. inlet and outlet
No. 5,	125.00 for	60,000 feet	3 in. inlet and outlet

PENBERTHY INJECTOR CO.

DETROIT, MICH.

BRANCHES

WINDSOR, CANADA

LONDON, ENGLAND

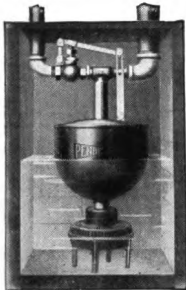
HANOVER, GERMANY

PARIS, FRANCE

**MANUFACTURERS OF INJECTORS, EJECTORS, VALVES, CELLAR
DRAINERS, STEAM SPECIALTIES AND LUBRICATING DEVICES**



Penberthy Automatic Injector



Penberthy Automatic
Cellar Drainer



Penberthy Regrind-
ing Valve



AUTOMATIC INJECTORS

Work Low, 20 to 22 lbs.

Work High, 165 to 170 lbs.

Lift Water, 20 to 24 feet

Handle Hot Water, up to 130°

Automatic Qualities.—The Penberthy Injector is a perfect restarting automatic machine. By this we mean, when the Injector is working and forcing water to the boiler, if the current of water be suddenly broken by any cause such as a sudden jar or jolt, the Injector will pick up the water and again establish the current to the boiler automatically, without the manipulation of a single valve or the least attention from an attendant.

Recognized standard of the world.

Sales 800,000 since 1886

AUTOMATIC CELLAR DRAINERS

The Penberthy Automatic Cellar Drainer is a Penberthy water pressure ejector of high capacity, automatically operated by a float-controlled, quick-opening-and-closing valve. This valve is never partially opened—it cannot leak, and allows the ejector to give its greatest efficiency by working to full capacity. Made in capacities to handle from 115 to 6500 gals. per hour.

REGRINDING VALVES

The ever increasing demand today by Power Plant owners and steam users in general is for valves that will give absolutely reliable service and dependability under high pressures and severe conditions, and that are free from unnecessary renewal of discs and repair parts. To meet this demand the Penberthy Regrinding Valve has been designed. It is the result of many years practical experience in the manufacture of high grade brass goods, and embodies the best mechanical ideas employed in mechanical construction. It is amply heavy, and the distribution of metal is such that parts subjected to the greatest strain and wear have proportionately heavier walls.

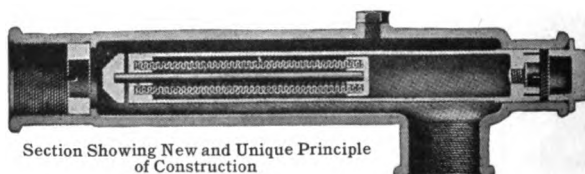
Complete Catalog No. 27 on request. Reply to Dept. CC.

SARCO ENGINEERING CO.

SOUTH FERRY BLDG., NEW YORK

and at Old Colony Bldg., CHICAGO

STEAM TRAPS, TEMPERATURE REGULATORS, RADIATOR TRAPS



Section Showing New and Unique Principle of Construction

STEAM TRAPS SARCO

The Steam Trap Sarco is by far the simplest trap sold. It consists of a steam pipe body which can be screwed on anywhere in a steam main or pipe occupying very little space and taking the place of an elbow or bend. In this body, a patent cartridge is inserted, containing an easily expansible fluid operating a corrugated tombac tube, to the lower end of which is attached a piston, which carries the valve head.

The trap requires simply to be put into position and the cartridge unscrewed a few turns. When the steam has heated up the cartridge, expanding the fluid and forcing out the piston, the cartridge is to be gently screwed forward, until the valve head meets the seat, closing off the steam. The adjustment is then perfect and can be locked when the trap works automatically. As soon as water collects, the liquid contracts and the valve opens; the condensation is ejected by the pressure behind it, and immediately the steam comes into contact with the cartridge, there is an expansion and the trap closes.

The Sarco Trap works continuously, thus it requires no large storage capacity such as increases the bulk and the cost of other traps.

There are 350,000 Sarco Traps and Radiator Traps in use.

There is no simpler form of trap manufactured or sold. There is practically nothing to get out of order; no levers, gauges, packing, stuffing boxes or trouble causers. It can be adjusted instantly, and we guarantee that when adjusted, no live steam will be emitted.

Being the simplest Trap made, it is the cheapest Trap sold.

LOW PRESSURE, 0 TO 50 LBS.

Size.....	$\frac{3}{8}$ "	$\frac{1}{2}$ "	$\frac{3}{4}$ "	1"	1 $\frac{1}{4}$ "	1 $\frac{1}{2}$ "	2"	2 $\frac{1}{2}$ "	3"
List Price.....	\$5.25	5.25	8.25	9.75	21.00	26.25	33.75	45.00	52.50

HIGH PRESSURE, 50 TO 200 LBS.

Size.....	$\frac{3}{8}$ "	$\frac{1}{2}$ "	$\frac{3}{4}$ "	1"	1 $\frac{1}{4}$ "	1 $\frac{1}{2}$ "	2"	2 $\frac{1}{2}$ "	3"
List Price.....	\$6.75	6.75	9.00	10.50	24.75	30.00	42.00	52.50	67.50

1 $\frac{1}{2}$ " and upwards with flanged connections and companion flanges.

For Vacuum, Vapor and Low Pressure Systems the SARCO TRAP is perfect.



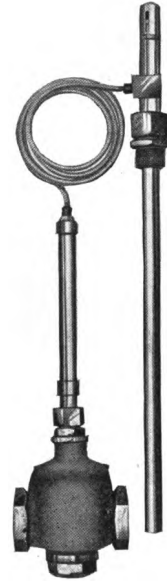
SARCO ENGINEERING CO.

TANK AND ROOM TEMPERATURE REGULATORS SARCO

The Sarco Regulators are made for maintaining a constant temperature of liquids and atmosphere, and are based on the same thermostatic principle as the well known and highly successful Steam Trap Sarco using as their actuating motive power the expansion of a sensitive liquid hermetically sealed within a chamber into which is inserted a spirally corrugated tube. They are substantially made and not liable to get out of order. They possess many advantages over thermostatic regulators at present on the market, in so far as they are compact, simple and wholly self-contained, requiring no exterior operating means such as compressed air, water or electricity. They also avoid the use of rubber or leather diaphragms which are of a perishable nature and of metal disc diaphragms which change their form with considerable resultant inaccuracy.

The Sarco Regulators are very substantially constructed and a slight increase in the temperature of the surrounding liquid or atmosphere expands the operating fluid, producing a powerful hydraulic pressure, tending to close the valve, while a decrease in the temperature produces immediately a responsive contraction of the fluid and a gradual opening of the valve. Thus the action of the regulators is positive and so reliable as to make them suitable for even the most delicate manufacturing processes as well as for ordinary room temperature regulation.

The Sarco Regulators operate steam, water or gas valves, and are being widely adopted. They can be supplied also with reverse valve to open with rise of temperature. They are suitable for public institutions, schools, hotels, breweries, packing houses, canning factories, bottle works, textile dye houses, paper mills, chemical factories, also for oil tanks, gas condensers, gas producers, ammonia stills and pasteurizers.



Sarco Temperature Regulator for Tanks, Containers, Kilns, etc.

103

SARCO ROOM REGULATOR

Size of Valve	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"
List Prices	\$40.00	45.00	50.00	60.00	70.00	90.00	105.00	130.00	170.00

SARCO TANK REGULATOR

Size Inches	Weight Pounds	Length Face to Face of Valve	List Price	Size Inches	Weight Pounds	Length Face to Face of Valve	List Price
½"	8	2¼"	\$75.00	2½"	37	8½"	\$115.00
¾"	8	3½"	80.00	3 "	51	10½"	135.00
1 "	9	3½"	85.00	4 "	81	11¾"	185.00
1¼"	13	4 "	90.00	5 "	132	13¾"	250.00
1½"	22	6 "	95.00	6 "	158	15½"	300.00
2 "	28	6½"	100.00				

The Sarco Regulator will operate on any temperature for which same has been previously set between a range of 86° to 212° Fahr. All regulators are set at factory for temperature desired. A variation therefrom within a regulating range of 20°(10°+ and 10°-) can be had by turning the regulating screw. Regulators for a higher or lower temperature than 86°-212° F. and for a wider range can also be furnished at small extra cost.

C. A. DUNHAM COMPANY

MARSHALLTOWN, IOWA

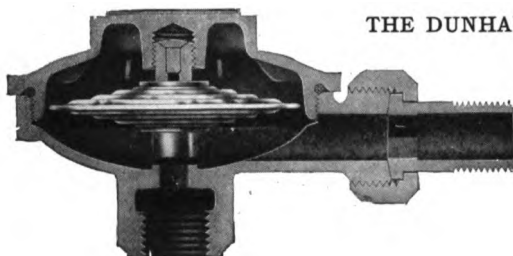
No. 1 Madison Ave.
NEW YORK

343 S. Dearborn St.
CHICAGO

611 Wells Fargo Bldg.
SAN FRANCISCO

CANADIAN FACTORY AND OFFICE: TORONTO, ONTARIO

MANUFACTURERS OF DUNHAM STEAM TRAPS AND VACUUM HEATING SPECIALTIES



THE DUNHAM RADIATOR TRAP

for use in connection with the Dunham Vacuum, Dunham Vacuo-Vapor and Dunham Vapor Systems of Steam Heating. It will positively allow for the complete discharge of water and air from the radiator to which it is attached without loss of steam. Constructed of phosphor bronze.

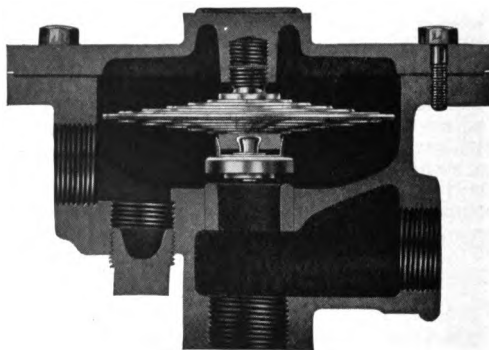
The Dunham Radiator Trap

Made in four patterns—Right hand, left hand, straightway and angle.
Size connections— $\frac{1}{2}$ inch pipe. Capacity—350 sq. ft. direct radiation.
Maximum steam pressure—10 lbs. Wt. $2\frac{1}{2}$ lbs.

THE DUNHAM BLAST TRAP

for use in draining blast coils in vacuum or other steam heating systems. Also for use on large direct radiating units where the Dunham Radiator Trap is too small. Positively opens for water and air and closes for steam. Body made of cast iron.

Care must be taken in reducing blast surface to equivalent direct by multiplying by a factor ranging from 3 to 9, depending upon the temperature, velocity and volume of air being forced over the coils.



The Dunham Blast Trap

Size	Capacity	Connection	Wt.
$\frac{3}{4}$ "	1500 sq. ft. direct radiation	$\frac{3}{4}$ " pipe	13 lbs.
1"	3000 " " "	1" pipe	21 lbs.

THE DUNHAM AIR VALVE

This valve is made for use in revamping both old and new air-line jobs. It is built upon the same principle as the Dunham Radiator Trap. Is made of cast bronze, nickel plated all over and has union nut and nipple. Made for $\frac{1}{8}$ inch pipe connection. Architects and engineers can specify this valve with the positive assurance that it will give service without necessitating the attention that is required to keep so many other air line valves in working order.

DUNHAM VACUO VAPOR SYSTEM

is simply a low-pressure system of heating that works upon pressure, vapor, and vacuum, without necessitating the use of a vacuum pump. It is particularly applicable to residence, apartment house, and church heating where low pressure (below 2 lbs.) boilers are used.

The Dunham Vacuum System is installed in such buildings as the Woolworth Bldg., N. Y.; 80 Maiden Lane Bldg., N. Y.; Insurance Exchange Bldg., Chicago; Sherman Hotel, Chicago, and hundreds of other buildings all over the country.

Complete information, catalog and prices will be sent on application.

ARMSTRONG CORK & INSULATION CO.

122 TWENTY-FOURTH ST., PITTSBURGH, PA.

Branch Offices in the Large Cities

NONPAREIL INSULATING BRICK for Boiler Settings, Furnaces, Core, Japanning and Mold Drying Ovens, Waste Gas Mains, Bake Ovens, Kilns, etc.; **NONPAREIL HIGH PRESSURE COVERING** for Steam Lines and Boilers, etc.; **NONPAREIL CORK COVERING** for Brine, Ammonia and Ice Water Lines; **NONPAREIL CORKBOARD INSULATION** for Cold Storage Plants.

NONPAREIL INSULATING BRICK

Nonpareil Insulating Brick are the most suitable form of insulation yet devised for reducing the heat loss by radiation from boiler settings, ovens, furnaces, kilns, etc. They have a high heat insulating efficiency, ten times that of fire brick or common brick, are very light in weight, yet sufficiently strong to be built in as an integral part of the structure to be insulated, and are easy to install, being readily cut and shaped.

Nonpareil Brick are made of diatomaceous earth (kieselguhr) and finely ground cork. In the process of manufacture the cork is burned out, giving the brick a peculiar porous structure. They weigh but $1\frac{1}{2}$ pounds each and the size of the standard straight brick is nominally $9 \times 4\frac{1}{2} \times 2\frac{1}{2}$ inches. Standard shapes for arches, circles, etc., are also carried in stock.

While Nonpareil Insulating Brick are not in any sense a refractory material they will withstand temperatures up to 1800° F., without shrinkage or change of form. They can be utilized to advantage to back up fire brick in any place where it is desired to reduce the escape of heat by radiation. Full size sample brick and literature will be sent on request.

NONPAREIL HIGH PRESSURE COVERING

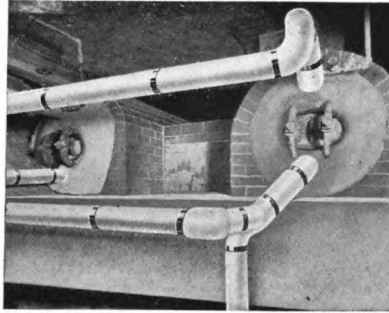
Nonpareil High Pressure Covering is composed of diatomaceous earth and asbestos fibre. Compared with other high pressure coverings, it is not only a better nonconductor of heat, but will withstand much higher temperatures without calcining or disintegrating. It is particularly well-suited, therefore, for the insulation of superheated steam lines, feed water heaters, etc. Moreover, it will bear repeated wetting and drying without injury, and for this reason is an ideal form of covering for underground steam lines. It is easy to apply—being furnished in sectional, block and plastic cement form—and so far as price is concerned, will compare favorably with any high-grade covering on the market.

NONPAREIL CORK COVERING

Nonpareil Cork Covering for brine, ammonia and drinking water systems in office buildings, mills, factories, etc., is composed of pure, granulated cork compressed and molded in sectional form to fit the different sizes of pipe and various fittings in ordinary use. Nonpareil Cork Covering is not only more efficient than other coverings when first applied, but remains so because it does not absorb moisture and will, therefore, not mold or rot. It is, moreover, light, clean, neat in appearance and easy to apply. Catalogue and sample on request.

NONPAREIL CORKBOARD

Nonpareil Corkboard is the world's standard cold storage insulation. It is composed of pure granulated cork, made into boards 12×36 inches, of various thicknesses from one to six inches. Descriptive literature and samples on request.



Steam Drums and top of boiler setting insulated with Nonpareil Insulating Brick. Steam lines insulated with Nonpareil High Pressure Covering. Chamber of Commerce Building, Detroit, Michigan

A. WYCKOFF & SON CO.

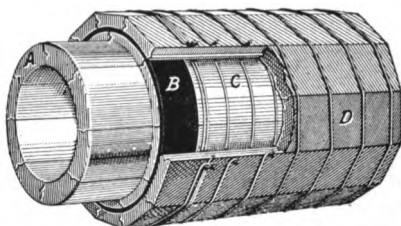
Established 1855

ELMIRA, NEW YORK

PITTSBURGH OFFICE
Pittsburgh Terminal Warehouse

CHICAGO OFFICE
551 West 14th Place

**MANUFACTURERS OF WYCKOFF'S IMPROVED STEAM CASING FOR
UNDERGROUND OR EXPOSED STEAM LINES**



A—2 Inch Thick Inner Shell.
C—Dead Air Space.

B—Asphaltum Packing.
D—1 Inch Thick Outer Shell.

106

WYCKOFF'S IMPROVED CYPRESS STEAM CASING MADE OF GULF CYPRESS, THE WOOD ETERNAL

Gulf Cypress is used instead of Pine or Tamarack because Gulf Cypress is the only known wood not affected by Wet or Dry Conditions. The outer shell is one inch thick, the inner shell two inches and the dead air space $\frac{1}{4}$ inch, making the total thickness of the casing $3\frac{1}{4}$ inches. These improvements will more than double the life of former Wyckoff casings. The asphaltum packing and the driven joint make the casing absolutely waterproof.

We make the casing in lengths of from four to eight feet. The lengths are connected by tenon and socket joints. In putting over the pipes it requires simply to be driven together.

This pipe casing is the **ONLY ONE** on the market with

$\frac{1}{4}$ " DEAD AIR SPACE BETWEEN THE SHELLS.

This dead air space between the shells has been increased 50 per cent over the former Wyckoff casing.

Send for our booklet to-day—it tells you all about these improvements.

AMERICAN BALANCE VALVE CO.

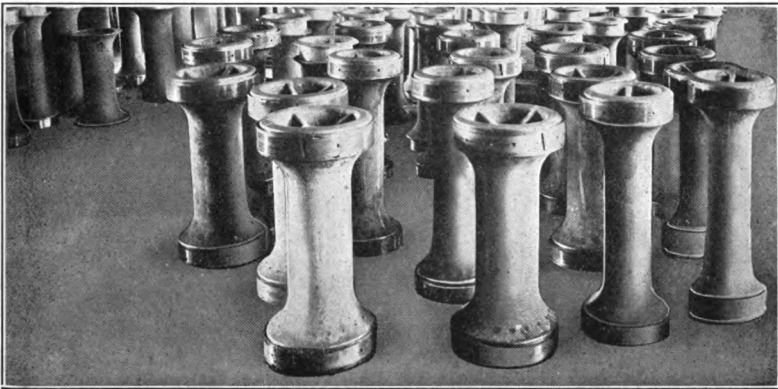
Established 1890

JERSEY SHORE, PENNA.

BALANCED MAIN VALVES FOR EVERY SERVICE

AMERICAN SEMI-PLUG PISTON VALVE

For Superheated Steam of Any Degree or Saturated Steam of Any Pressure up to 1000 Pounds

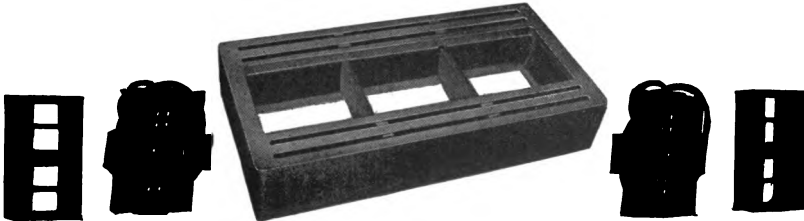


These Valves are Frictionless, are Steam-tight and *REMAIN SO*. They are Maintained by *DUPLICATE* parts from *STOCK*. When under Pressure this Valve is a *PLUG* and when without Pressure it is a Snap Ring Valve.

Can be fitted to any Piston Valve Engine.

JACK WILSON HIGH PRESSURE SLIDE VALVE

Double-Ported. For Pressures up to 240 Lbs. and Superheat to 600° F.



BALANCED in all positions of travel. Double Admission, Double Exhaust and made for Internal or External Admission.

Can be fitted to any Slide Valve Engine.

When Designing or Repairing Engines, you should investigate these Modern Balanced Valves. *Descriptive matter cheerfully furnished.*

THE PICKERING GOVERNOR CO.

PORTLAND, CONNECTICUT

GOVERNORS FOR STEAM ENGINES AND TURBINES, GAS ENGINES,
MECHANICAL CONTROL AND SPEED LIMIT

THE PICKERING GOVERNOR

Owing to the absence of joints our Governors are very responsive to slight changes in load, moving quickly and positively into correct position for maintaining the admission of steam proportionate to the duty required of the engine. Absence of joints gives maintenance in efficiency under continued and severe duty.



Fig. 33

Class B. represents Governor with Speed Ranger by use of which the speed of Engine can be varied while in motion. Sawyers Lever is also included.



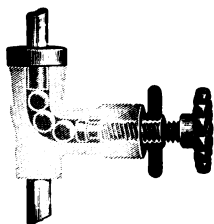
Pickering is standard for specifications in Steam practice the world over.

We offer our services with over fifty years successful experience.



Fig. 34

Class A, to which is added the Automatic Safety Stop. This Stop closes valve when belt breaks or runs off Pulley, and is simple and certain in its action.



Detail of the Speed Ranger

All Governors equipped with Wide Range Speed Changer.

U. S. & Foreign Patents.

Greatest range in speed adjustment with close regulation at all points.

We build to meet special conditions whenever practicable and are pleased to submit suggestions on request.

TABLE OF DIMENSIONS, ETC., FOR CLASSES A AND B

Size of Governor Diameter of Opening	1½	1¾	2	2½	3	3½	4	4½	5	6	7	8	9	10
From center of inlet to base	3½	3¾	4½	4¾	5½	5¾	6½	7½	7¾	8	8¾	9	10	11½
Extreme Height	20½	23½	25½	27½	27½	32½	33½	41½	41½	46½	49½	53½	55½	60½
Extreme expansion of Balls	7	8	8	9	9	10	10	13	13	15	16½	18	20	20
Speed of Governor	350	380	380	300	300	340	340	320	320	275	275	260	260	225
Dia. of Pulley on Governor	2½	3½	3½	4	4	4	4	5	5	6	7	7	8	8
Dia. of Cyl. 300 ft. Piston Speed	6	7	9	10	12	14	16	18	20	22	26	31	36	45
" " 400 " " "	6	6	8	9	10	12	14	16	18	20	23	27	31	35
" " 500 " " "	4½	5	7	8	9	10	12	14	16	18	21	24	28	31
" " 600 " " "	4	4½	6	7	8	9	11	13	15	16	19	22	25	28

For complete table and for sizes below 1¼—
see our general catalogue.



ALBANY LUBRICATING CO.

ADAM COOK'S SONS, Props.

708-10 WASHINGTON ST., NEW YORK

MANUFACTURERS OF LUBRICATING OILS AND GREASES



Albany Grease is a pure lubricant so compounded that it automatically maintains a film of oil between rubbing surfaces, reducing friction losses to a minimum. It contains no adulterants and is guaranteed not to oxidize, gum or corrode the metal of the bearings. Made in different consistencies to meet different temperature conditions.

You must consider two things when lubricating machinery of any kind. First—Is the lubricant efficient? Does it give perfect satisfaction at all times or only part of the time? Second—Is the lubricant economical? Does it do its work at the lowest possible cost or is it wasteful?

Albany Grease is efficient and economical at all times. It is efficient because it will lubricate any kind of machinery and line shafting perfectly.

It can be used in any kind or style of grease cup and will not gum, cake or clog. It will not corrode, neither will it turn a reddish color, showing that it contains no acids. Albany Grease will remain a golden yellow to the end.

It is economical because it stays where you put it and does not run or leak away. When the machine is not in operation, Albany Grease does not flow. It will flow just enough to give perfect lubrication—no more. These are facts that you should bear in mind when buying a lubricant.

Albany Grease will show wonderful results on Line Shafting and Loose Pulleys, also on Steam, Gas, Gasoline or Oil Engine Main Shaft Bearings, Crank Pins, Eccentric and Slides. On special machinery, such as Printing Presses, Shoe machinery, Coal and Metal Mine equipment, Sugar machinery, Cotton, Woolen and Paper Mill installations, Lumber Camp machinery, Wood Turning, Sawing machines and Steel Mills, it gives the best of service. In fact no matter what kind of machinery you have, Albany Grease will lubricate it so that it will operate perfectly, keeping it cool and easy running, and reducing depreciation to a minimum.

Albany Grease is made in several different consistencies to meet various conditions and temperatures. Use the right consistency for your work and you will have absolutely no trouble.

SOFT NUMBERS (No. 0 and 1) for slow running, heavy machinery or where equipment is operated outdoors or low temperature has to be contended with.

MEDIUM NUMBERS (No. 2 and 3) for general machinery and shafting, the former is known as a winter grease and the latter as a summer grease. These are the most general and called for numbers.

HARD NUMBERS (No. X, XX, XXX) for use in places where the Soft and Medium numbers are not adapted, especially where the temperature surrounding the bearings is high. The No. XXX has the highest melting point with great lubricating value.

Due to the wide publicity given Albany Grease, unscrupulous concerns occasionally substitute inferior goods for our product. When purchasing Albany Grease, insist that our trade mark appear on the package.

We also refine and manufacture in addition to Albany Grease, lubricating oils and greases to meet all requirements. No matter what your lubricating proposition may be, we can supply your entire wants. We will be glad to send complete data covering the entire lubrication of your equipment and place at your disposal expert engineering service.

THE TEXAS COMPANY

NEW YORK AND HOUSTON

MANUFACTURERS OF LUBRICATING OILS, ENGINE AND MACHINE OILS AND GREASES. LUBRICATING OILS PREPARED ESPECIALLY FOR USE OF TURBINES, GRAVITY-FEED AND FORCE-FEED SYSTEMS UNDER ALL CONDITIONS

It would be, indeed, difficult to find a business or industry in which some Texaco Lubricant has not been able to show definite lubricating economy.

This universal application of Texaco Lubricants has given our Lubricating Staff a fund of experience, and a mass of correlated data that is beyond comparison.

It means that we can come into your business, with all guesswork eliminated, and prescribe the lubricant or lubricants particularly and peculiarly suited to your requirements.

Our field includes everything from the small isolated units, to huge industrial and manufacturing plants.

In the larger plants lubrication is a problem carrying extra gravity, due to the severe conditions of work and it is here that the value of Texaco Lubricants is most forcibly demonstrated.

Texaco Lubricants are peculiarly fitted to meet severe conditions. They lubricate perfectly, separate readily from any water that may get into the oil through leakage and they stand up well under severe work, maintaining as high lubricating properties after a thousand hours as shown, when the oil was new.

Another very essential feature contributing to the general excellence of Texaco Lubricants is their low cold test. This is especially important in large stations where the oil is pumped from a central filtering plant to the engine. It will eliminate the shutting down of the station in cold weather on account of the oil having congealed.

The Texaco Oils for general, rolling-mill and manufacturing plant lubrication are of such a nature that great economy will result in their use. Every requirement of lubrication, whether power economy, general plant economy, or cost can be met by Texaco Lubricants.

We solicit inquiries, address Lubricating Division, The Texas Company, 17 Battery Place, New York City.



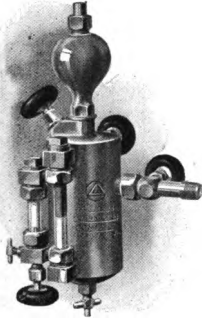
DETROIT LUBRICATOR COMPANY

DETROIT, MICH.

MANUFACTURERS OF LUBRICATORS, FORCE FEED OILERS, OIL AND GREASE CUPS, AIR AND GAUGE COCKS, PRIMING CUPS, BALANCED THROTTLE VALVES, WATER GAUGES, POP SAFETY VALVE, FUSIBLE PLUGS AND RADIATOR VALVES.

DETROIT SIGHT FEED LUBRICATORS.

Detroit Lubricators are made in a sufficient variety of styles and kinds to properly lubricate the valves and cylinders of all types of steam engines, steam pumps, gas engines, air compressors, etc. The complete line includes over 125 styles and sizes of lubricators—one for every kind of service.



Standard Lubricator

IMPROVED STANDARD LUBRICATOR

Double Connection

For use on all kinds of steam engines, steam pumps, etc.

Installed with both connections between the boiler and the throttle.

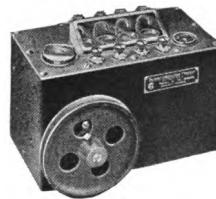
Finished in polished brass or nickel plated.

Size	$\frac{1}{4}$ Pt.	$\frac{1}{2}$ Pt.	1 Pt.	1 Qt.	$\frac{1}{2}$ Gal.	1 Gal.
Pipe Thread on Support Arm....	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{4}$

DETROIT FORCE FEED OILERS

Detroit Force Feed Oilers are designed for the mechanical lubrication of gas and gasoline engines, air compressors, etc. The advantages of this system of lubrication are: cool, clean oil forced by mechanical pressure and in quantities as needed to the proper point to be lubricated, the elimination of the possibility of injury from running dry or carbon deposits, and very little attention from the operator as there is only one tank to fill.

They are made with 1 to 30 feeds and corresponding capacities of 3 to 18 pints, using a standard tank, $4\frac{3}{8}$ " wide and 5" high. Special models for gas tractors, marine and stationary engines, automobiles, commercial trucks and aeronautical motors.



Four Feed Force Feed Oiler

DETROIT LOCOMOTIVE LUBRICATORS

Detroit Locomotive Lubricators are thoroughly suited to fulfill all the requirements of every style of locomotive from the saturated simple engine to the most modern superheated Mallet. The No. 22 Type of Bullseye Lubricators is recommended as possessing improvements and refinements made desirable by the needs of modern locomotive practice, resulting in a low cost of maintenance and economy in oil. Made with from one to eight feeds.



Three Feed Locomotive Lubricator

DETROIT RADIATOR VALVES

Detroit Radiator Valves embody in their design the results of years of experience in the manufacture of all kinds of valves for all styles of heating installation. The Detroit Packless Valve fulfills the need for a radiator valve that will not leak around the stem nor need repacking. Its construction makes it perfectly adapted also for use in vacuum systems where tightness is essential.



Packless Valve

McCORD MANUFACTURING CO.

DETROIT, MICH.

NEW YORK OFFICE
50 Church St.

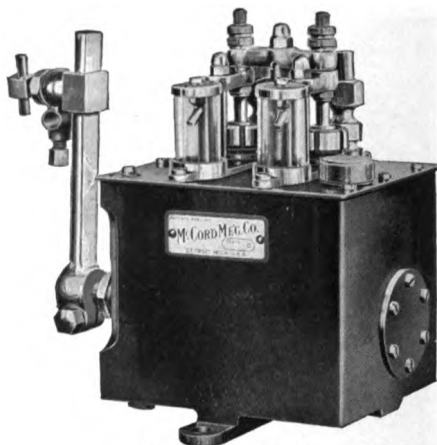
CHICAGO OFFICE
Peoples Gas Bldg.

FORCE FEED LUBRICATORS, GASKETS, AUTOMOBILE RADIATORS

THE "McCORD" FORCE FEED LUBRICATOR

Is made in from 1 to 14 feeds and has a separate pump for each feed. Each pump has individual adjustment. It has constant sight feeds which show exactly how much oil is being pumped to each bearing and the flow can be adjusted from one drop to a full stream per stroke.

It is positive and automatic in action and operates in perfect synchronism with the engine or pump it is lubricating. It is not affected by viscosity of oil, variations in steam pressure or length of feed lines.



Class B—Two Feed

Note these standard features *and*
Positive sight feeds without pressure
Separate pumps capable of individual adjustment for each feed
Forced delivery of oil against pressure up to 1000 pounds, etc., etc.

These special features.
Heating Chamber
Auxiliary Hand Crank for accelerating feed
Drop forged operating lever
Reversible End Bearing
Plug for draining reservoir

There is positively no pressure in sight feed; all working parts are of the best drop forged steel and operate in oil. Rotary or Ratchet drive. Finish—full Nickle Plate or Black Enamel and Brass. Straightaway Spring Check Valves. Heating Chamber and Auxiliary Hand Crank furnished as extras when specified.

ALL PRICES F. O. B. DETROIT

No.	Capacity	Feeds	List	No.	Capacity	Feeds	List
1	1 Quart	1 Feed	\$25.00	11	1 Gallon	5 Feed	\$57.00
2	1 Quart	2 Feed	30.00	12	1 Gallon	6 Feed	63.00
3	2 Quart	1 Feed	28.00	13	1½ Gallons	7 Feed	75.00
4	2 Quart	2 Feed	35.00	14	1½ Gallons	8 Feed	82.00
5	2 Quart	3 Feed	42.00	15	1½ Gallons	9 Feed	90.00
6	2 Quart	4 Feed	49.00	16	1½ Gallons	10 Feed	96.00
7	1 Gallon	1 Feed	33.00	17	2 Gallons	11 Feed	108.00
8	1 Gallon	2 Feed	39.00	18	2 Gallons	12 Feed	115.00
9	1 Gallon	3 Feed	45.00	19	2 Gallons	13 Feed	125.00
10	1 Gallon	4 Feed	51.00	20	2 Gallons	14 Feed	135.00

DOUBLE COMPARTMENT LUBRICATORS FOR AIR COMPRESSORS AND ICE MACHINES

21	2 Quart	2 Feed	1 Feed in each	\$44.00
22	2 Quart	3 Feed	2 & 1 Feed in each	50.00
23	2 Quart	4 Feed	2 Feed in each	57.00
24	1 Gallon	2 Feed	1 Feed in each	47.00
25	1 Gallon	3 Feed	2 & 1 Feed in each	54.00
26	1 Gallon	4 Feed	2 Feed in each	60.00

For Heating Chamber add \$1.00 to list. For Auxiliary Crank add \$1.00 to list.

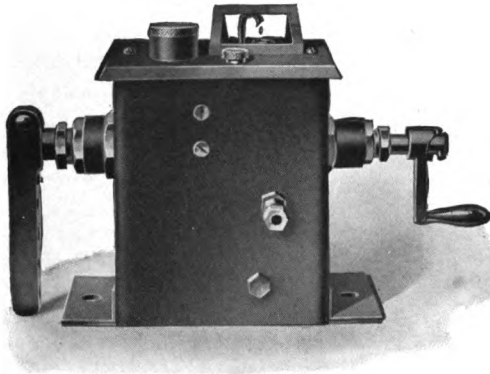
See Catalog "I" for Details

MADISON-KIPP LUBRICATOR CO.

Established in 1898

MADISON, WIS.

VALVELESS FORCE AND SIGHT FEED MECHANICAL LUBRICATORS



MODEL 50 SIGHT FEED TYPE

Built in any number of feeds

113

THE PRINCIPLE IS VALVELESS

The Madison-Kipp Lubricator has no springs and balls involved in its mechanism. The pumping and forcing is done by ground hardened steel rotating plungers fitted into ground barrels, all contained in the tank of oil. The ratchet is made of case hardened steel with a one inch face and it is placed inside of the tank running constantly in oil.

PERFORMANCE PERFECT IN ALL TEMPERATURES AND AGAINST ALL PRESSURES

The Kipp no valve principle makes the lubricator absolutely positive in handling cold or warm oil without change in adjustment. Each lubricator is tested in the factory to force oil against 2000 pounds pressure. The position of all parts inside of the tank, where they are continuously lubricated, eliminates all wear.

THE SIGHT FEED AND ADJUSTMENT

The sight feed tubes extend above the cover and are protected by a transparent hood, through which can be seen the exact amount of oil being delivered. The adjusting buttons for each feed are placed opposite the tubes, and adjustment can be made down to a fraction of a drop for each stroke of the plunger.

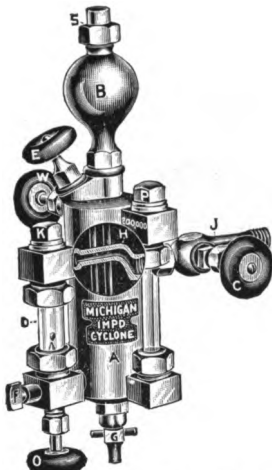
The Madison-Kipp is the original Valveless Mechanical Lubricator. It has enjoyed sixteen years of success.

MICHIGAN LUBRICATOR COMPANY

Established 1883

DETROIT, MICH.

MANUFACTURERS OF SIGHT FEED LUBRICATORS, HAND OIL PUMPS, GLASS AND BRASS OILERS, GREASE CUPS, OIL GAUGES, WATER GAUGES, AIR COCKS, GASOLINE COCKS, PRIMING CUPS, AND RADIATOR VALVES



Michigan Cyclone Lubricator

MICHIGAN SIGHT FEED LUBRICATORS

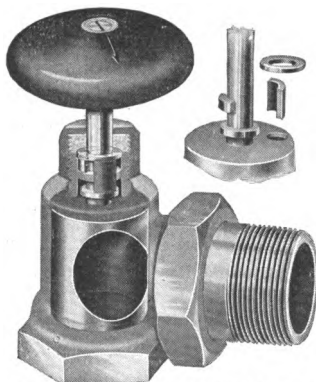
The Michigan Lubricators comprise a variety of styles, each being adapted to a particular type of engine, such as Lubricators for locomotives, Lubricators for stationary engines, Lubricators for dredging engines, Lubricators for portable and traction engines, Lubricators for steam pumps, Lubricators for air compressors, and Lubricators for gasoline engines. The designs and features employed in the different styles are based on more than 30 years' experience in furnishing these articles to the various prominent builders of engines and compressors throughout the United States and in many foreign countries.

Our Cyclone Lubricator is adapted for use on stationary engines and is made in $\frac{1}{8}$ pint, $\frac{1}{2}$ pint, 1 pint, 1 quart, $\frac{1}{2}$ gallon, and 1 gallon sizes.

Our Brass Body and Glass Body Oil Pumps are also very widely used as emergency devices in case the lubricator should become injured or be temporarily out of service for any other cause.



Michigan Hand Oil Pump



Michigan Hot Water Radiator Valve
(Patents Pending)

MICHIGAN RADIATOR VALVES

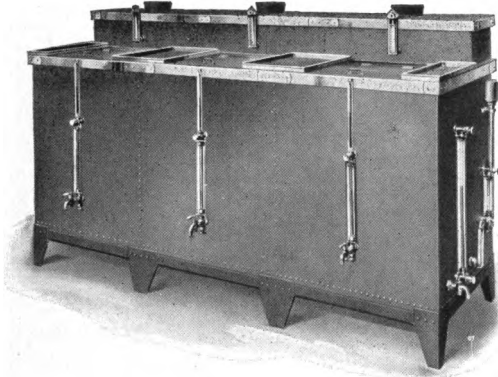
The Michigan Steam and Hot Water Radiator Valves combine simplicity of design with structural strength. The accompanying sectional view of our Hot Water Valve shows a very simple and ingenious construction without a single element in its make-up which could become a source of weakness or trouble.

THE RICHARDSON-PHENIX CO.

126 RESERVOIR AVE., MILWAUKEE, WIS.

LUBRICATION ENGINEERS AND MANUFACTURERS

OILING AND FILTERING SYSTEMS FOR POWER PLANTS



Peterson Power Plant Oil Filter
Built in Capacities of 100 to 1000 Gallons per Hour
Described in Catalog S-10

We advise and quote on the necessary material and apparatus or design and install complete Automatic Cylinder and Bearing Lubrication Systems, in which the oil is regularly and positively supplied in just the proper quantities and, in the case of bearing lubrication, is filtered and used over and over again.

Our experience in this work, extending over a period of many years, has placed us in possession of valuable data on this subject and there is hardly a question pertaining to machinery lubrication that we have not met and solved.

We would be pleased to correspond with those interested in automatic lubrication, with a view of explaining our proposition in greater detail.

We Manufacture

The Richardson Sight Feed Oil Pump,
The Phenix Mechanical Lubricator,
The Richardson Oil Filter,
The Phenix Oil Filter,
The Peterson Power Plant Oil Filter,
Individual Oiling and Filtering Systems,
Central Oiling and Filtering Systems,
Sight Feed Oilers,

Gang Oilers,
Union-Cinch Pipe Fittings,
Telescopic Oilers,
Oil Pumps,
Oil Sinks & Fountains,
Sight Flow Indicators,
Automatic Pump Governors,
Tank Level Indicators, etc.

Systems for Storing, Measuring and Pumping Gasoline, Lubricating and Paint Oils, Varnishes, Drugs and Kindred Liquids.

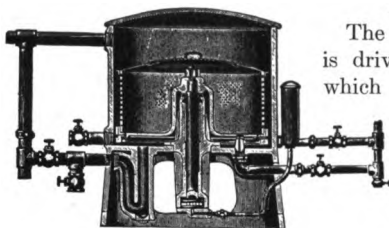
Ask for Literature Describing Any of the Above.

Our plant is the largest one devoted exclusively to the manufacture of lubrication Appliances. We manufacture "EVERYTHING FOR LUBRICATION BUT THE LUBRICANTS."

THE OIL AND WASTE SAVING MACHINE COMPANY

1509 REAL ESTATE TRUST BLDG., PHILADELPHIA

**MANUFACTURERS OF MACHINERY FOR SEPARATING AND RECLAIM-
ING OIL AND WASTE, CENTRIFUGAL OIL FILTERS, OIL EXTRACTORS
FOR CLEANING OILY CHIPS**



Waste Machine

IMPROVED WASTE MACHINE

The basket or waste receptacle in the machine is driven by direct connected steam turbine, which exhausts into the basket; heating and liquefying the oil and grease, which is extracted from the waste, towels or rags by centrifugal force. The machine is then filled with water, and the waste, towels or rags thoroughly washed and sterilized; after which same is dried by the machine for future use.

Guaranteed saving of 90% of the oil and all of the waste. Requires little attention. Over 3,000 machines in use. Made in 10", 15", 20" and 36" sizes with respective capacities of $\frac{1}{2}$ cu. ft., 1 cu. ft., 2 cu. ft., and 8 cu. ft. of waste, rags or machinery towels per charge.

CHIP SEPARATOR

For Extracting Oil from Metal Chips and Small Parts

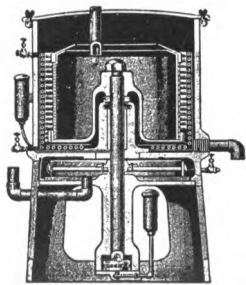
This machine is steam turbine driven, the turbine exhausting so that the heat from the steam comes in contact with the basket containing the oily chips, etc. This liquefies and allows the centrifugal force to thoroughly extract the oils. Built with 24 in. diameter basket, of $3\frac{1}{2}$ cu. ft. capacity, and has steam hoist attached for removing and dumping the basket.



Chip Separator

TURBINE CENTRIFUGAL OIL FILTER

Will remove all foreign matter, all moisture or emulsion from and sterilize the oil. Driven by direct connected steam turbine. The filter requires very little steam to operate same, owing to its design and its being equipped with a ball step-bearing; requires little care in operation and has practically no wearing parts.



Centrifugal Oil Filter

SPECIFICATIONS

Size	15"	20"
Base measurements.....	21"x21"	27"x27"
Height.....	30"	40"
Weight.....	450 lbs.	800 lbs.
Steam pressure required to operate....	20 lbs.	40 lbs.
Steam consumed per hour of operation....	83 lbs.	138 lbs.
Oil filtering capacity per hour.....	20 to 30 gals.	50 to 60 gals.

UNITED LEAD COMPANY

111 BROADWAY, NEW YORK

Offices in All Principal Cities

SPECIALISTS IN LEAD PRODUCTS

LEAD WOOL

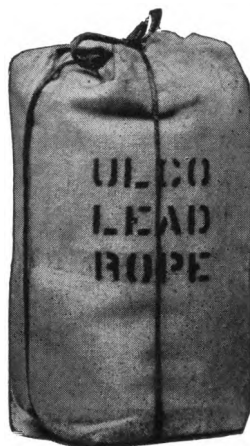
LEAD ROPE

LEAD PIPE

SHEET LEAD



Lead Wool for Calking C. I. Pipes



Lead Rope for Steam and Water Packing

117

Ulco Lead Rope: For making metallic packing, we put up Lead Rope in varying diameters; this material is sold lubricated or not, as requested. For stuffing boxes and valve stems, the lead rope should be freely saturated with graphite and oil; for making gaskets it is enclosed in cheese cloth, like a cigarette; for steam packing it may be rolled in cheese cloth, thoroughly saturated with graphite and oil.

Special packing rings are made to order. We make any size or form, price governed by size and quantity.

Lead Wool is recommended for calking cast iron pipes where large quantities of the material are required. This material properly placed in a joint never works out.

ULCOLOY

The new acid resisting metal, made from copper and lead.

Anti-friction and bearing metals.

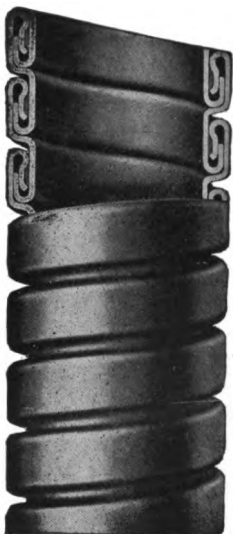
UNITED Lead Lined Iron and Brass Pipe.

If made from lead we make it. Send for catalogue.

THE AMERICAN METAL HOSE CO.

WATERBURY, CONN.

MANUFACTURERS OF FLEXIBLE METAL HOSE AND TUBING



Section B. D. 15 Bronze
Steam Hose Showing
Interlocking Joints

AMERICAN METAL HOSE is just what the name implies—a Hose made of metal.

We manufacture Flexible Metal Hose for all the purposes for which rubber hose is used. Its strength and lasting qualities make it the most efficient and economical Hose on the market.

While rubber hose gives fairly good results when used in certain easy services such as carrying air and water, in the more severe duties it is unsatisfactory and expensive on account of the frequent replacements necessary. Rubber is a vegetable compound which rapidly deteriorates under the action of Oils, Alkalis and the intense heat of Steam, consequently no hose with rubber in its composition will last any length of time when used to convey any of these agents.

American Metal Hose is made from a continuous strip of high tensile strength Phosphor Bronze or well galvanized Steel, the edges of which are turned in during the process of manufacture to make the "Interlocking" joints shown in the accompanying illustration. It has the strength of metal combined with great flexibility, and is in no way effected by the heat of Steam or the chemical action of Oils. In addition to the above advantages Metal Hose will successfully withstand very high pressures. We can supply special Metal Hose for pressures up to 6000 lbs. per square inch.

American Metal Hose of the "Interlocking" construction is, from its very nature, a high pressure Hose, and is our standard for conveying Steam and Oils. In addition to this Hose, we are making several other types for carrying Air, Water, Gas, etc., and for Vacuum.

Its permanent nature makes American Metal Hose an admirable substitute for swing or telescoping joints and rigid piping on machines where a flexible connection is desired for conveying Steam or Oil. It is particularly adapted to use on presses where a constant supply of Steam must be fed to the moving parts.

We are prepared to furnish Couplings of any description with our Hose. Prices and full particulars on application.



Government Inspector Testing American Metal Hose for the U. S. Navy Department

THE B. F. GOODRICH COMPANY

AKRON, OHIO

Offices in all principal cities

MANUFACTURERS OF MECHANICAL RUBBER GOODS, TIRES, ETC.

HOSE

WATER HOSE covers a wide range of usage, making it quite out of the question to advance any specific recommendations as to quality.

"White Anchor," "Akron" and "Commander,"—special grades for unusual conditions of service.

"Triton," "Cascade," "Deluge,"—regular grades for all general purposes. Braided fabric water hose—in either smooth or corrugated cover.

STEAM HOSE must be heavily constructed to stand the pressure, and the inner lining must be so compounded as to resist the action of steam under varying temperatures.

"Goodrich,"—for high pressure. This is truly a long-life hose.

Special coverings for steam hose: Red Painted woven cotton cover, Woven Marlin Cover, Asbestos Wire-Wrapped cover.

PNEUMATIC HOSE wrapped duck—50' length style:

"Goodrich"—the highest quality for the hardest service.

"Akron"—the standard hose, for all general purposes

Wire-wrapped pneumatic tool hose.

Braided-Fabric Pneumatic Hose—Mainstay smooth or Pinnacle Ribbed.

AIR DRILL HOSE is heavily constructed throughout with a layer of canvas on the outside as a protection against cuts and abrasions.

"Goodrich"—exceptionally high quality, unequalled for wear.

"Quarry"—our standard grade and biggest seller.

BOILER WASHOUT HOSE is made in extra heavy weight to withstand the rough service it encounters. We advocate our heavy "Boiler Washout Hose" for turbine tube cleaner work. Made in 3 grades, "Goodrich," "Safety" and "Akron."

SUCTION HOSE is made in a variety of grades to suit any purpose, either smooth or rough bore style.

DREDGING SLEEVES, OIL SUCTION HOSE, OIL WELL DRILLERS' HOSE, OIL CONDUCTING HOSE, GASOLINE HOSE, SAND BLAST HOSE, COKE HOSE, MARINE DECK HOSE, all especially adapted to the purposes for which they are made.

PACKING

RED SHEET PACKING—an excellent product, in two grades.

RED SHEET BRASS WIRE INSERTED in the same grades.

DIAPHRAGM AND CLOTH INSERTION: Packing highly recommended for their proper uses.

SUPERHEAT PACKING, a combination of rubber and asbestos, especially adapted for high pressures.

RED TUBULAR GASKET PACKING, SPIRAL SQUARE DUCK PACKING, ROUND AND SQUARE DUCK PACKING, SQUARE RUBBER BACK, ROUND PISTON PACKING, AND PURE GUM STRIPS all made to supply the demand for these various kinds.

RUBBER GASKETS

All grades and shapes. No matter what your requirements may be, we can supply them.

"GOODRICH" RUBBER PUMP VALVES

There is no class of our product which we take greater pride in stamping with the Goodrich trade mark. Our list of grades is complete; we are always glad to give special attention to unusual conditions.

Made in grey or red rubber.

MOLDED RUBBER GOODS

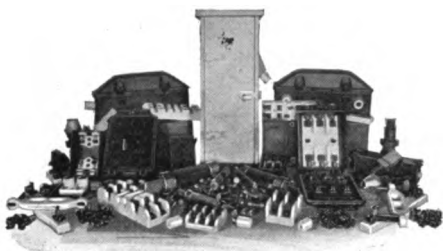
We have a large Department in our factory devoted exclusively to the manufacture of Molded Rubber articles of every description—Diaphragms, Bumpers, Springs, Cushions, Tips, Balls, Billiard Cushions, Parts for Automobiles, Truck Wheel Tires, Discs for Steam and Radiator Valves, Special Articles used in connection with the Oil Industry, Sugar Factories, Creameries, Breweries, Laundries, Rubber Parts for Plumbing Devices, Carpet Sweepers, Vacuum Cleaners, etc. A large part of this class of our business lies in the direction of strictly special articles made to customers' specifications, to meet individual requirements. Our product is of uniformly good quality and excellent finish.

THE JOHNS-PRATT COMPANY

HARTFORD, CONN., U. S. A.

THE H. W. JOHNS-MANVILLE CO., N. Y., SELLING AGENTS

MANUFACTURERS OF "NOARK" ENCLOSED FUSES AND PROTECTIVE DEVICES, "J. P. BAKELITE" INSULATION, "MOULDED MICA" INSULATION AND "VULCABESTON" INSULATION AND STEAM PACKING.



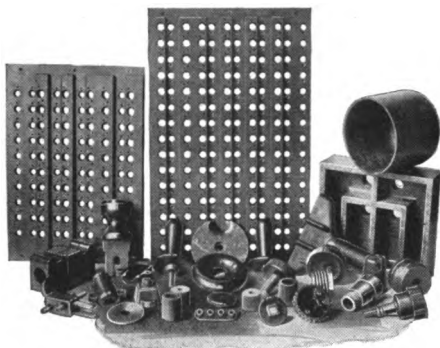
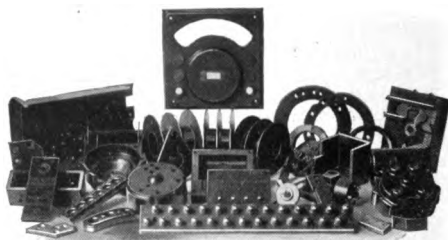
"NOARK"

ENCLOSED FUSES, CUT-OUTS, SWITCHES AND ACCESSORIES.

SUBWAY JUNCTION BOXES AND ELECTRIC PROTECTIVE DEVICES DESIGNED TO MEET EVERY REQUIREMENT.

"J-P" BAKELITE

INSULATION MOULDED WITH OR WITHOUT METAL INSERTS FOR SERVICE UNDER SEVERE TEMPERATURE CONDITIONS.



"MOULDED MICA"

INSULATION MOULDED WITH OR WITHOUT METAL INSERTS FOR USE UNDER MODERATE TEMPERATURE CONDITIONS.

"VULCABESTON"

INSULATION COMPOSED LARGELY OF ASBESTOS. PACKING FOR STEAM, HOT WATER AND AMMONIA.



CATALOGUE SECTION
PART II

**Power Transmission Machinery
Elevating and Conveying Machinery
Hoisting and Transporting
Machinery**

121

Pages 121—178

THE A. & F. BROWN CO.

Established 1854.

Incorporated 1898.

79 BARCLAY STREET,
NEW YORK CITY

WORKS:
ELIZABETHPORT, N. J.

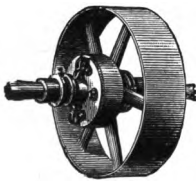
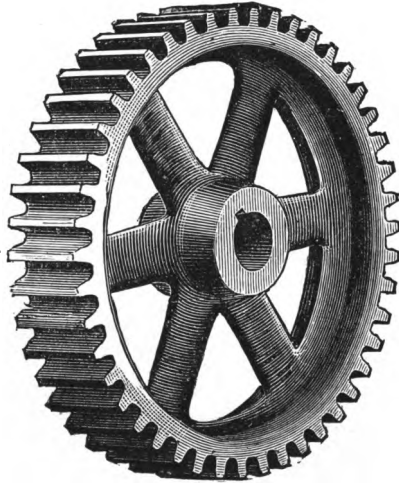
**ENGINEERS, FOUNDERS, MACHINISTS AND MILLWRIGHTS.
MANUFACTURERS OF GEARS OF ALL DESCRIPTIONS, TURNED STEEL
SHAFTING, PULLEYS, SPLIT PULLEYS, FRICTION CLUTCHES, SPECIAL
MACHINERY, ETC.**

CUT GEARS

These gears are cut on the best up-to-date automatic machines obtainable, enabling this department of the shops to turn out accurately cut gears of every description and size.

MACHINE MOULDED GEARS

The Gear Department of our foundry is fitted up with the most modern gear moulding machines, enabling us to furnish machine moulded gears up to 16 feet diameter, and 25 tons in weight if in one piece, and heavier if split, or built up. These gears are much more accurate than ordinary cast gears and are of the toughest mixture of iron.



FRICTION CLUTCHES

The F. Brown Friction Clutch is simple, compact and having few small parts is not liable to get out of order; engages gradually and when thrown "in gear" has a stronger grip than any other, owing to the large friction surfaces and powerful operating device which is a combination of double ended (or right and left thread) screw and toggle joint.

SIRENS

These fog signals are used by the United States Navy and Light house Departments, also by a number of foreign governments and many steamships. They are also in use as fire alarm signals in small towns and large manufacturing plants.

COGSWELL MILL

The problem of grinding or pulverizing many materials has been successfully solved by this machine.

SPECIAL MACHINERY

These shops are particularly well equipped for building special machinery to plans and specifications. The pattern shop, foundry and machine shops are strictly up to date in all particulars and equally well equipped to turn out work of the heaviest character as well as light machinery requiring first class material and workmanship and most modern tools.



THE FALK COMPANY

MILWAUKEE, WISCONSIN

**MANUFACTURERS OF PRECISION HERRINGBONE GEARS WITH
STAGGERED TEETH (WUEST PATENTS)**

WUEST HERRINGBONE GEARS

We manufacture a complete interchangeable system of herringbone gears, with teeth generated on special machines, designed and built exclusively for our own use.

The gears which we produce are hobbed, both sides at once, in solid blanks.

A Large Set of
Wuest Gears
for a
Sheet Mill

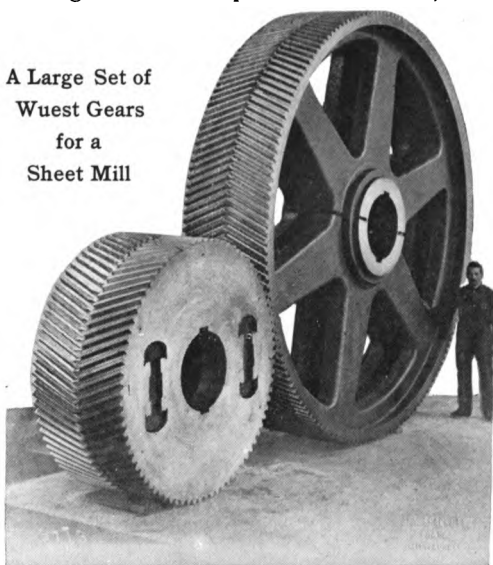


Fig. 1

The Wuest System of staggered teeth, besides giving the maximum contact surface for a given width of face, is invaluable in securing unbroken continuity of engagement when using high ratio pinions with very few teeth.

Other distinctive features:—

Highest attainable accuracy.

Involute tooth form on *circumferential* section.

Invariable spiral angle.

Perfect interchangeability.

Equal efficiency in both directions.

Wuest herringbone gears transmit power by smooth, continuous action without jar, shock or vibration.

They are almost noiseless.

They can be used for extremely high *single* gear ratios. In this connection we make a specialty of forged pinions in one piece with their shafts. Ratios of 15 to 1 are quite normal and 20 to 1 may be used when necessary. Wuest gears can be run with safety at far higher velocities than the spur type. Special gears for use in connection with steam turbines are suitable for speeds up to 7000 feet per minute.

Referring to illustrations, Fig. 1 shows the largest pair of herringbone gears that have ever been produced on a hobbing machine. Fig. 2 shows an application of high ratio gears for a large vertical triplex pump. Fig. 3 is a standard turbine gear unit forced lubrication type.

THE FALK COMPANY

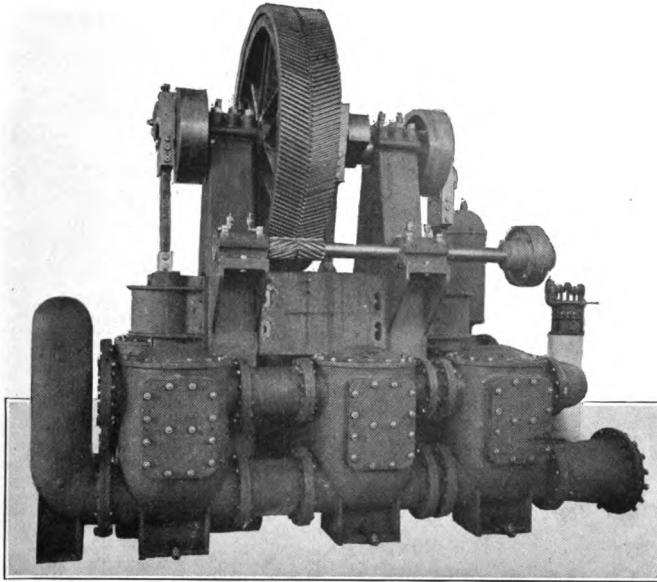


Fig. 2

SPECIAL ADVANTAGES

Long life.
 High efficiency (loss never exceeds 1% at rated load).
 Elimination of countershafts and double-gear trains.
 Absence of vibration with prevention of shaft crystallization and breakdown of motor insulation.
 Quiet action with durable steel pinions.

SIZES

We manufacture hobbled herringbone gears in the following sizes:
 Any pitch, from 10 D.P. to $\frac{3}{4}$ D.P.
 Any face, from $1\frac{1}{4}$ inches to 72 inches.
 Any diameter, from 2 inches to 16 feet.
 True spiral gears of constant angle cut to standard diametral pitch like spur gears.

The range of application for Wuest herringbone gears covers every case where spur gears are used and many new fields where spur gears are impossible.

Specially adapted for
 Marine Steam Turbines.
 Turbo-Generators.
 Turbine-driven centrifugal pumps, mills and shafting.
 Rolling Mills and Rod Mills.
 Tube Mills and Crushing Plant.
 Power Pumps.
 Air Compressors and Blowers.
 Hoisting, Elevating and Conveying Plant.
 Rubber Machinery.
 Machine Tools.

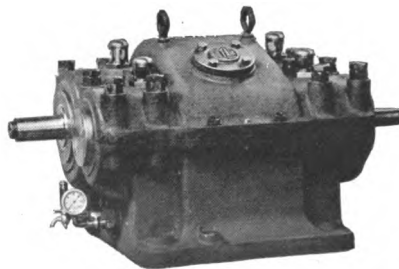


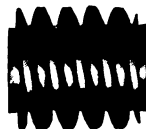
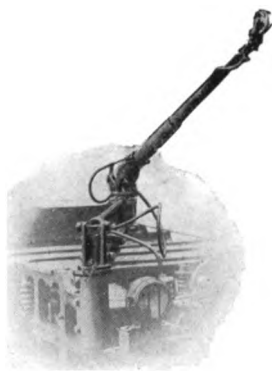
Fig. 3

R. D. NUTTALL COMPANY

PITTSBURGH, PA.

MACHINE CUT GEARS—COUPLINGS—TROLLEYS

For Every Known Railway, Mining and Industrial Application



Railway Motor Gears
Haulage Locomotive
Gears and
Forged Steel Pinions

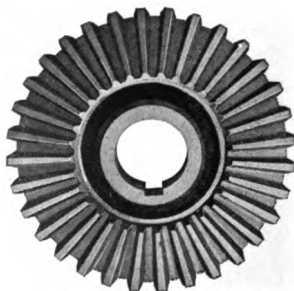
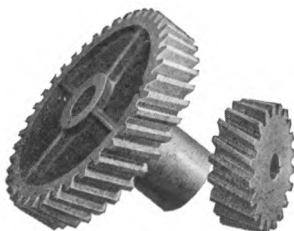


Forged Steel Gears and Pinions
Oil Tempered or Case Hardened



Industrial Gears

Spurs	up to 60 feet
Bevels	20 feet
Spirals	6 feet
Herringbone	30 feet
Worm Gears	12 feet
Internals	30 feet

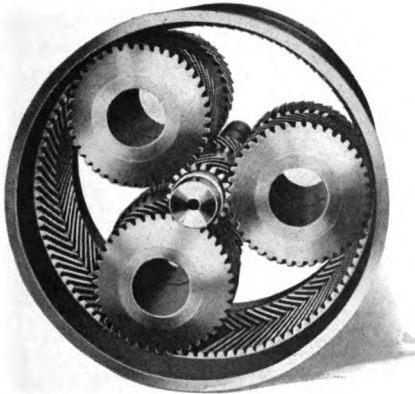


Trolleys and Flexible Couplings for Any Service

TURBO-GEAR COMPANY

BALTIMORE, MD.

ORIGINATORS OF THE "INTERNAL HERRINGBONE" GEAR



THE TURBO-GEAR (Fast Patents)

Generated on special machine built for our own use.

True involute stub-tooth form, 20° pressure angle.

1. DRIVING AND DRIVEN SHAFT IN ONE LINE.

2. PERFECT LUBRICATION (FORCE FEED).

3. PERFECT BALANCE OF ALL PRESSURES ON SHAFTS.

4. ALL ROTATING PARTS SUPPORTED AT BOTH ENDS DIRECTLY BY CASING.

5. SILENT RUNNING.

6. HIGH EFFICIENCY (98% to 99%).

VERY HIGH RATIOS IN SINGLE TRAIN GEAR. SAME EFFICIENCY FOR SPEED INCREASING AS FOR SPEED REDUCING.

LUBRICATION: The high speed shaft has a central passage through which the oil is pumped and a "continuous stream" of oil is sprayed on the gears through radial passages in the pinion.

The high speed bearings beside having "force feed lubrication" are provided with "oil rings" and a good size oil reservoir for emergency use.

Superfluous oil from the high speed bearings is collected by a centrifugal oil ring and forced through the hollow spindles carrying the intermediate gears, flushing their bearings.

The oil after lubricating bearings and gears is immediately drained to the main reservoir in the base of the housing: here it is strained, cooled, returned to the pump and used over again:

It will thus be seen that the gears "do not run in oil," which causes considerable back pressure at high speeds with corresponding loss in efficiency.

SUITABLE FOR:

Steam Turbines (Land and Marine Service).

Turbo-Blowers (Electric Drive).

Centrifugal Pumps.

Power Pumps.

Air and Ammonia Compressors.

Blowers.

Mills.

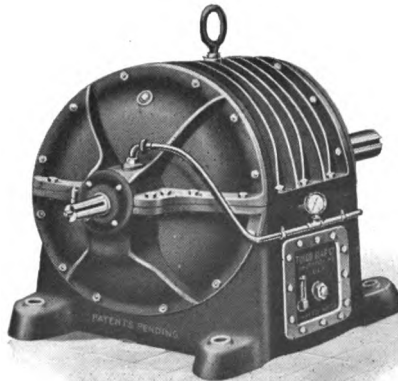
Line Shafts.

Conveying Machinery.

Elevators (Special Design).

Automobiles (Special Design),

Etc.



External View

FALLS CLUTCH & MACHINERY CO.

CUYAHOGA FALLS, OHIO

NEW YORK, N. Y.
206-208 Fulton St.

BRANCHES
BOSTON, MASS.
52-56 Purchase St.

CINCINNATI, O.
134 W. Second St.

SHAFTING, PULLEYS, HANGERS, FRICTION CLUTCH PULLEYS, FRICTION CLUTCH COUPLINGS, PILLOW BLOCKS, COUPLINGS, COLLARS, HEAVY BEARINGS, BASE PLATES, FLOOR STANDS, HEAD SHAFT HANGERS, AND ALL OTHER POWER TRANSMITTING MACHINERY

FALLS FRICTION CLUTCH PULLEYS AND CLUTCH CUT-OFF COUPLINGS

have been designed by forming a combination of mechanical movements, which are the acme of simplicity and strength, and represent a generation of mechanical research for obtaining the highest possible efficiency, in the saving and distribution of Power.

There is absolutely no contact of frictional surfaces when not in clutch.

They represent a high starting torque. All parts are accessible and easily adjusted, fitted with babbitted or bronze lined sleeves, which are interchangeable. These are held in position by means of cap screws, and, when worn, can easily be removed, rebabbitted and relined, and placed in position without disturbing the pulley on the shaft.

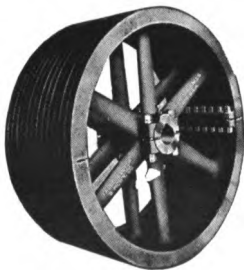


4-Arm Friction Clutch Pulley

FALLS SYSTEM OF ROPE TRANSMISSION

The flexibility of Rope Transmission has long been recognized by Engineers as an ideal means of power distribution, which is accomplished by two distinct methods: The English or Multiple System, and the American or Continuous System. The English System is usually preferred on main drives of large units, while the American, or Continuous wrap system operates successfully from small to large loads and on long or short centers, horizontally, vertically, parallel, or at any angle to each other. On the latter system the use of Tension Carriages is essential to keep a uniform tension at all times on the rope, economy in first cost and maintenance being the initial feature.

We supply complete Equipment, and furnish Competent Engineers to design and estimate for any contemplated installation.



Rope Sheave

CAST IRON PULLEYS AND PATENT STEEL RIM PULLEYS, either-Solid or Split, Single or Double Arm.

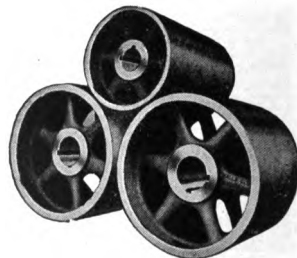
HAMMERED FORGINGS for Shafting purposes on larger diameters, and **DRAWN OR TURNED** on smaller sizes.

Complete line of **BEARINGS**, made dust-proof, Self-Oiling, Ring-Oiling, or for Grease Lubrication.

BASE PLATES, HEAD SHAFT HANGERS, AND FLOOR STANDS, suitable for any conditions.



Competent Corps of Engineers at your Service.



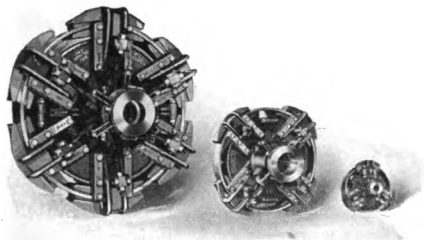
Plain Pulleys

THE HILL CLUTCH CO.

CLEVELAND, OHIO

New York Sales Office, 50 Church St.

A COMPLETE LINE OF POWER TRANSMISSION MACHINERY FOR BELT AND ROPE DRIVES, INCLUDING THE WELL KNOWN PATENTED HILL FRICTION CLUTCH (SMITH TYPE) AND COLLAR OILING BEARINGS.



Hill Friction Clutches—Three, Four and Six Arm Design

HILL FRICTION CLUTCHES

(Smith Type)

The new Smith Type of Hill Clutch is the result of over thirty-one years' experience in manufacturing Friction Clutches.

All working parts are removable without disturbing shaft, hub or pulley. Friction surfaces are positively disengaged. No springs.

Self-centering—requires no troublesome bushing in ring hub to align shafts. Toggle mechanism made of steel and forgings.

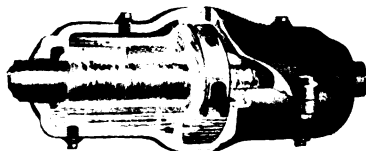
Built solid or split.

HILL COLLAR OILING BEARINGS

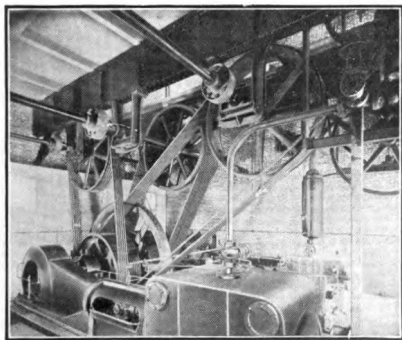
Hill Collar Oiling Bearings minimize power losses. Instead of depending upon a loose ring or chain for conveying oil to the journal, a fixed collar is employed.

Oil stored in large reservoirs in bottom of the bearing is continuously and positively elevated to the top reservoirs, and then flows by gravity over the entire bearing surface.

Heavy, split oil collar clamped to the shaft also acts as a thrust collar, eliminating the necessity of outside shaft collars except in case of very severe end thrust.



Sectional View of Collar Oiling Bearing



Hill Rope Drive Installation

HILL ROPE DRIVES

American and English System Rope Drives designed, built and installed.

Our twenty-one years' experience enables us to recommend the best method of installing each individual drive to meet customers' requirements.

Preliminary information gladly offered free of charge to all contemplating the installation of new drives or changes in their present system.



THE MOORE & WHITE CO.

ESTABLISHED 1885

PHILADELPHIA, U. S. A.

FRICTION CLUTCHES

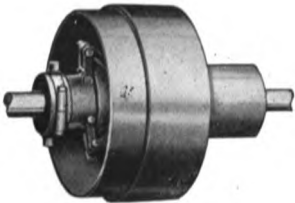
FRICTION CLUTCH PULLEYS

FRICTION CLUTCH COUPLINGS

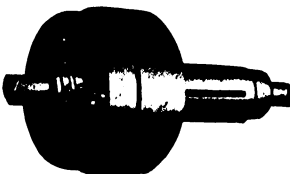
For all Speeds and Horse Powers



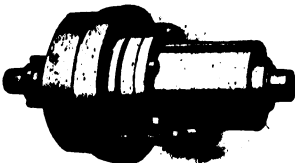
Friction Clutch Sheave Wheel



Friction Clutch Cut-Off Coupling



Friction Clutch with Sleeve



Friction Clutch with Ball
Bearing Sleeve

The illustrations on this page show our standard line of High-speed Friction Clutches.

Having had 30 years' experience in building Friction Clutches for all classes of work, several years ago we put on the market a standard line of High-speed Friction Clutches to meet all requirements of leading Engineers in this and other countries.

The chief difficulty encountered with Clutches for high speed work has been the lubrication problem. We have eliminated this difficulty and made our Clutch so that it is impossible for it to throw oil due to centrifugal force. When oil is thrown from a Clutch your Belting and other materials are soon destroyed. This feature alone makes our Clutches especially adapted for use in food factories, flour mills, textile mills, paper mills and laundries.

They are designed so as to meet the laws for preventing accidents. All moving parts are self-contained and free from dust or any foreign substance.

The simplicity of construction of Moore & White High-speed Clutches makes expert mechanical knowledge unnecessary to understand the principles of adjustment and operation. The discs in these Clutches are made of bronze and thereby give a longer life than wood-filled Clutches as used for ordinary service up to 400 R.P.M. All parts are interchangeable, designed for severe service and for operating at the least possible upkeep expense.

The particular advantage of all Moore & White Friction Clutches, and the reason they are used exclusively by many leading engineers, is due to their mechanical stability, starting power, simplicity.

When selecting a Friction Clutch it is well to choose one backed by a house of established reputation.

Send for free Friction
Clutch Catalogue.



THE MOORE & WHITE CO.

ESTABLISHED 1885

PHILADELPHIA, U. S. A.

VARIABLE SPEED CHANGES

Arranged to give any desired variation, allowing the variation to be made without stopping the machine to change belts.

With this device, cone pulleys are transformed into plain high face pulleys which take all undue strain off the driving belt. They remove all difficulties experienced with driving belts on taper cone pulleys and the necessity of using narrow belts.

The belt contact is changed from a conical surface to that of a regular crowned face pulley so that belts of any desired width or kind may be used.

The Transformers can be made to suit cone pulleys now in operation. The Transformer consists of a flexible leather band for each cone, with the inner surface self-adjusting to cone pulley and the outer surface crowning.

The Moore & White Speed Changes dispense with friction and waste of power; there is absolutely no end thrust or wear on belt.

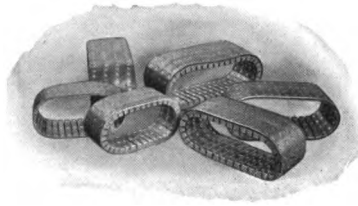
The Speed Change is theoretically and mechanically correct, and is built in a very substantial manner. The tension on the driving belt may be easily adjusted.

The variation of speed can be changed quickly by means of shifter, operated either by a hand wheel or a chain wheel. Any desired variation of speed can be secured.

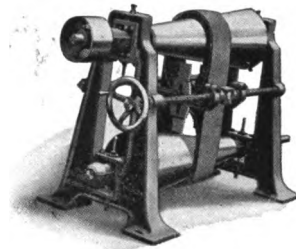
The Moore & White Speed Change was originally brought out for use in paper mills where very fine gradations of speed must be obtained while transmitting great horse power.

There are thousands of them in use today driving all kinds of machinery requiring variable speed.

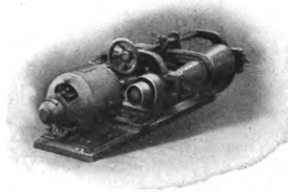
Send for free Speed Change Booklet.



Transformers



No. 5 Speed Change



No. 2 Speed Change with Motor



No. 7 Speed Change

FARREL FOUNDRY & MACHINE CO.

Established 1848

ANSONIA, CONN.

COIL FRICTION CLUTCHES

Patented



132

The illustration shows a group of Coil Friction Clutches for Rubber Mill lines. This clutch is particularly well adapted to the transmission of power at the slower speeds. The construction is very simple and the materials are the best for the purpose. There are very few parts to the clutch so that adjustment is easily made and the cost of upkeep is very low.

The Farrel Coil Friction Clutch consists of but three essential members, a drum forming the driving member, the coil and the plate to which it is fastened, the driven member, and a suitable means of control, which varies with the amount of power to be transmitted. The drum is cast of carefully selected iron, chilled and highly polished, while the coil is made of high carbon steel of great tensile strength. Due to the principle on which it operates no other type of clutch affords the delicacy of control that is the greatest advantage of the spiral band and drum. For this reason the Farrel Coil Clutch is particularly adapted for haulage, rolling mills, and similar service where very heavy units must be frequently started without shock.

As an example of the small amount of space required by the clutch in comparison with power transmitted, an eighteen-inch clutch coupling will transmit 425 H.P. at 100 R.P.M. These clutches are made in various types for different requirements and are furnished with either mechanical or magnetic control. They are also made in sizes capable of transmitting from 5 to 8000 H.P., their rating being based on a speed of 100 R.P.M.

Catalogue and information on request.

THE AMERICAN PULLEY COMPANY

4200 WISSAHICKON AVE., PHILADELPHIA

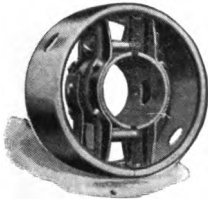
33 Greene St.
NEW YORK

165 Pearl St.
BOSTON

124 S. Clinton St.
CHICAGO

536 First Ave., So.
SEATTLE

"AMERICAN" ALL STEEL SPLIT PULLEYS



(Patented)

3", 4", 5" and 6" DIAMETERS

Note the sturdy construction. These small pulleys are as perfect in their way as larger "American" pulleys. No more can be said.



(Patented)

INTERMEDIATE SIZES

Provided with grooved air escape. Six flat "A"-braced arms (edge on) give great rigidity and least air resistance. Riveting the ends of the arms to inner flange means a round pulley, strong where strength is needed.



(Patented)

44" TO 84" DIAMETERS

Grooved air escape. The hub shell is solidly riveted to half an annular hub ring of angle section. Eight arms, bifurcated at the base, are riveted through lap-joint bifurcations to an annular hub ring.

Good for Double Belts

The original steel pulleys. Made for twenty years. Nearly 2,500,000 marketed.

These pulleys are correctly designed, and every detail of construction has been carefully studied.

The manufacturers invite experimental tests as to all points of efficiency—Belt holding qualities of pulley face, method of crowning, economy as to air fanning, ease of application, high speeds, safety, ultimate strength, etc.

Data has been collected as to each point, and will be furnished on application.

The manufacturers will coöperate with engineers wishing to arrive at the actual facts as to efficiency, putting their testing apparatus at the disposal of inquirers.

AMERICAN PULLEYS

All "Americans" above 6" diameter have grooved faces.

Stocked by over 200 dealers in the United States and Canada.

Stock sizes 3" to 84"—larger diameters on application.

Crown and straight faces.

Interchangeable Bushings.

No Set Screws, and no Keyways unless for unusually heavy duty.

All pulleys fully guaranteed.

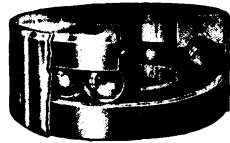
AUBURN BALL BEARING COMPANY

22 ELIZABETH STREET, ROCHESTER, N. Y.

MANUFACTURERS OF AUBURN BALL THRUST BEARINGS, ANNULAR BALL BEARINGS, STEEL, BRASS AND BRONZE BALLS



T-114



T-100

AUBURN FOUR POINT CONTACT BALL THRUST BEARINGS

The race grooves of Auburn Thrust Bearings are made such that the points of contact with the balls lie on the surface of a true cone. Each ball contacts constantly with both an inner (shorter) and an outer (longer) track on each race, yet it slides on neither of the four tracks, but rolls as freely as in a straight line across a table, and thus practically without friction. Open Style T-114 Self-Contained Bearing is used in protected places. Enclosed Style T-100 Self-contained Bearing is employed in exposed positions where protection from chips and dirt is necessary. Style T-101 (not shown) is used when the allowable space for the bearing is limited. Write for bulletins, giving shaft speed and thrust load conditions.

BEARINGS MADE FOR UNUSUAL CONDITIONS

We have many standard design bearings up to 26 inches outside diameter in simple and multiple types, also double thrust bearings in several styles. We design and make special ball bearings for unusual conditions of service when bearings of regular size or design are not entirely suitable. Send particulars of your problems.



COLLARS AND RACES of tool steel, hardened and ground, made to customers specifications. Send Blue Prints of sizes for quotation.



STEEL BALLS, of Alloy Tool Steel to highest degree of accuracy, also Carbon Tool Steel Balls in various grades and Polishing or Tumbling Barrel Balls.

BRASS and BRONZE BALLS, solid or hollow, for valve purposes. Also Balls of other metals for various purposes. Inquiries solicited.



GURNEY BALL BEARING COMPANY

JAMESTOWN, N. Y.

GURNEY BALL BEARINGS



In the Gurney Ball Bearing, by virtue of certain refinements in its construction, the applicability of the annular type is extended in the following definite particulars.

First—In mere *Capacity*—By reason of the more correct and exact contour of the raceways made possible by our special grinding machines.

Second—*Higher Speeds Possible*—By reason of our process of Concentric Grinding.

Third—*Larger Thrust Loads Permissible*—Due to its unique construction, safely carrying thrust loads much

in excess of those possible with any other radial bearing, while in our Radio-Thrust bearing thrust loads are carried up to 150% of the rated load of the bearing.

All Gurney bearings are made of the best obtainable chrome steel. The heat treatment of the steel is in accordance with the latest metallurgical science, and with the latest and best equipment.

Gurney Radio-Thrust Bearings are specially applicable not only where there is a combination of thrust and radial loads but in certain cases they are superior to ordinary thrust bearings for carrying simple thrust loads. They work with much less friction than the ordinary thrust ball bearings. Hence where speeds are high they carry thrust loads with greater efficiency.

Radio-Thrust Bearings are made to the same dimensions as regular annular bearings and interchangeable therewith. They are also made in a wide series interchangeable with common double row ball bearings. Adapted to take various degrees of thrust.

The application of ball bearings in various special cases, such as the worm drive, the spiral bevel gear, internal gear drive, etc., etc., is very exhaustively covered in the Gurney Ball Bearing Engineering Bulletin, which is published from time to time and sent free to those requesting such special service.

The Gurney Ball Bearing Handbook is the most exhaustive exposition of the application of ball bearings to motor cars ever compiled. It gives very complete data and formulas for calculating loads in all cases.



It is supplied in a loose-leaf leather binder for..... \$2.75
In pasteboard covers for..... 1.75
Loose-leaf, perforated for standard binder, for..... 1.50

THE HESS-BRIGHT MFG. CO.

PHILADELPHIA, PA.

MANUFACTURERS OF ANNULAR AND THRUST BALL BEARINGS

HB

HESS-BRIGHT BALL BEARINGS

DWF

are used in

Lineshaft Hangers

Machine Tools

Dynamos and Electric Motors

Trolley Cars

Woodworking Machinery

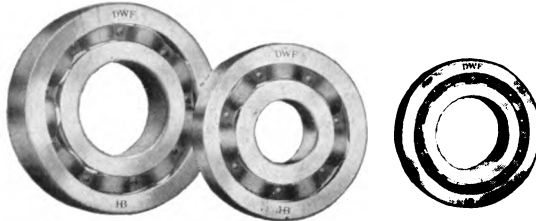
Flour Milling Machinery

Automobiles, etc.

Special literature on request, describing the above and other applications.

Aside from the economy in power which they make possible, Hess-Bright Ball Bearings effect important savings in repair and upkeep charges, due to the fact that wear is virtually absent.

ANNULAR BEARINGS



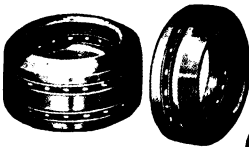
HESS-BRIGHTS of "heavy," "medium" and "light" series, for same shaft size

Made regularly in sizes up to 110 mm. (4.3307 inches) shaft diameter. Special sizes to order if quantity is sufficient.

Three series: "Heavy," "Medium" and "Light," for equal shaft sizes. Regular and high-speed types.

Hess-Bright Annular Bearings are so constructed that the sides of the races are unbroken. This fact has an important bearing on durability.

THRUST BEARINGS



HESS-BRIGHT
THRUST BEARINGS



Made regularly in sizes up to 140 mm. (5.5118 inches) shaft diameter. Larger sizes on special order.

Two series: "Medium" and "Light."

One-direction and two-direction types with or without aligning washers, though the use of such washers is recommended.

Our plants are the largest in the world devoted exclusively to ball bearing manufacture, and with the extensive enlargements and improvements which we have made (our factories now cover approximately 15 acres of floor space), we feel justified in saying that our resources and facilities for immediate delivery are unequalled.

HYATT ROLLER BEARING, CO.

NEWARK, N. J.

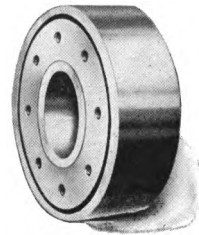
CHICAGO

DETROIT

There is a HYATT FLEXIBLE ROLLER BEARING for every turning shaft and revolving wheel.

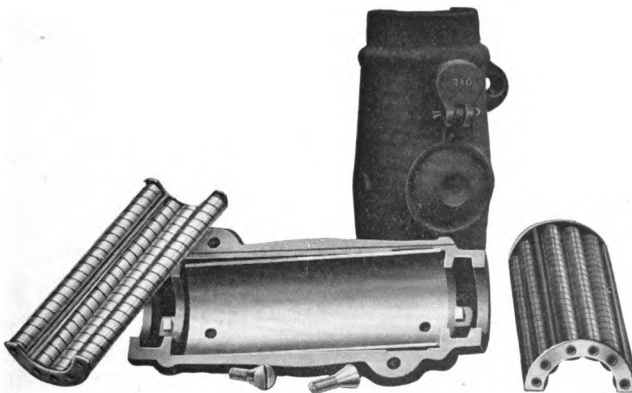
The Hyatt High Duty bearing meets those conditions where close limits are demanded, for it is a precision bearing. Where greater tolerances are allowed the Hyatt Standard Type is applicable, and for shafting there is the Hyatt Line Shaft Box.

All types embody the Hollow Flexible Roller—a distinctive Hyatt feature which insures a full line contact—an even distribution of the load over the entire bearing surface.



**HIGH DUTY
TYPE BEARING**

Hollow Rollers mean large oil carrying capacity while the right and left hand spiral assures the distribution of oil over the entire bearing surface. This not only tends to lengthen the intervals between which oil is essential but makes it a carefree Bearing—the Bearing of Highest Practical Efficiency.



THE HYATT LINE SHAFT BOX

THE NEW DEPARTURE MFG. CO.

BRISTOL, CONN.

Western Branch
1016-17 Ford Building,
DETROIT, MICHIGAN

Distributors
in all Trade Centers
of the United States

Sole British Agents
Brown Bros., Ltd.
LONDON-MANCHESTER

NEW DEPARTURE

Double Row

Single Row

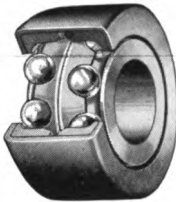


BALL BEARINGS

Radax

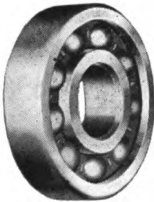
Magneto

AMERICAN MADE FOR AMERICAN TRADE

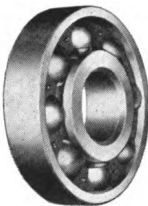


THE DOUBLE ROW is a distinctive, dual purpose, self contained unit, developed, patented and guaranteed by this Company. It has two sets of balls and raceways, mounted in such relation that radial loads and end thrusts, singly or combined, are successfully resisted.

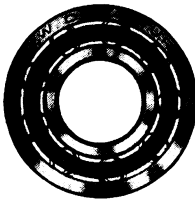
The most efficient and economical bearing for use in 75% of all places where ball bearings can be used.



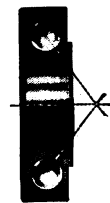
THE SINGLE ROW, in diameter, width and bore, is Internationally standardized and, therefore, interchangeable with other makes of bearings of this type. Maximum number of large balls, improved separator. A strictly radial bearing for use where stresses come at right angles to axis of rotation.



THE RADAX, a cup and cone bearing with angular load line of 35° from normal. For use where one direction thrust is present, either singly or combined with radial load. In dimensions it is interchangeable with corresponding sized single row annular bearings. Structural improvements have made the Radax the leader of its type.



THE MAGNETO, designed to carry light loads at high speeds. Due to the design of the races and slight angular contact line, it will sustain light end thrusts as well as radial loads, and the accuracy with which it is made and finished renders it noiseless in operation.



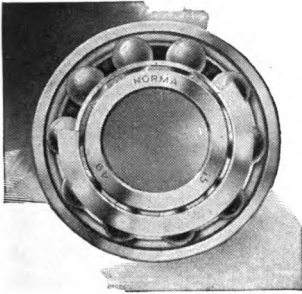
Made in a large variety of sizes: Prompt shipments: Unexcelled Service.

Send for a set of our Engineering Data Sheets.

THE NORMA COMPANY OF AMERICA

1790 BROADWAY, NEW YORK, N. Y.

"NORMA" BALL, ROLLER, THRUST AND COMBINATION BEARINGS

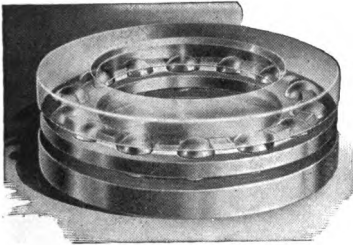
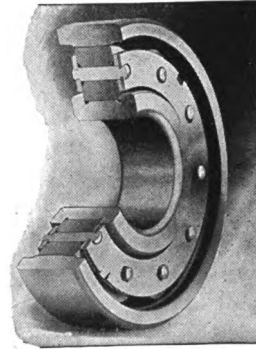


"NORMA" BALL BEARINGS

Open type, separable bearings of extremely high precision, rigidly mounted, silent running, with every element in workmanship and design contributing to high-efficiency, long-time service; notably successful in high-speed operation, being the standard bearings with most of the leading manufacturers of high-speed electrical apparatus.

"NORMA" ROLLER BEARINGS

Heavy-duty, high-efficiency bearings preëminently adapted for service where shock, jar, vibration and sudden load variations must be encountered; double the load capacity of a ball bearing of the same dimensions; temporary overload capacity up to 50 per cent of their own rating; high-speed, quiet-running units of extreme precision and maximum durability.



"NORMA" THRUST BEARINGS

Precision units affording maximum anti-friction efficiency under end thrust loads; designed to afford long-service durability and silent running qualities; made in several styles, single and double, both without housings and with housings of several types giving self-contained advantages.

"NORMA" COMBINATION BEARINGS

Self-contained units affording perfect adjustment and maximum anti-friction efficiency under combined radial and thrust load; two types—combined annular and ball thrust, and combined roller and ball thrust; distinguished by high precision, open type construction, rigid mounting, silent running and high speed qualities.

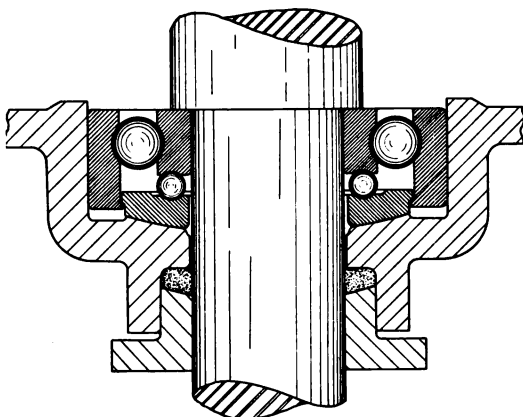


Send for the complete catalog
"Norma Precision Bearings."

U. S. BALL BEARING MFG. CO.

OFFICE AND WORKS, OAK PARK, ILL.

RADIAL, THRUST AND COMBINATION BALL BEARINGS TO SUIT ALL CONDITIONS



For the past six years, we have been manufacturing nothing but the highest grade of ball bearings, both radial and thrust type for all manner of service.

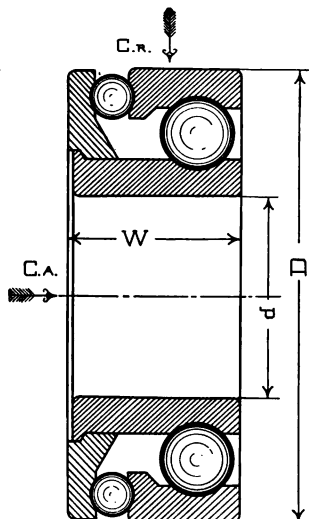
To take care of the demand for a ball bearing that will safely take both radial and thrust load, we have designed our adjustable combination bearing.

It is impossible to cramp this bearing in any way as the thrust part operates independent of the radial.

Its use will reduce your cost and allow for compactness of design in any installation where it is necessary to provide against both radial and thrust load.

Send for our catalogue and full information.

- D* Outside Diameter
- d* Inside Diameter
- W* Width
- Cr* Safe Radial Load at 500 Rev. p. m.
- Ca* Safe Thrust Load at 500 Rev. p. m.



TYPE H

Larger sizes made, but not listed

Nos.	d. mm	D. mm	W. mm	Cr. Lbs	Ca. Lbs	\$
204-H	20	47	20	385	440	5.05
205-H	25	52	21	460	485	5.60
206-H	30	62	22	680	595	6.65
207-H	35	72	25	790	750	7.30
208-H	40	80	29	1035	960	8.00
209-H	45	85	30	1145	1045	9.55
210-H	50	90	31	1190	1135	11.05
211-H	55	100	34	1275	1410	13.30
212-H	60	110	35	1650	1560	15.40
213-H	65	120	40	2090	1935	17.50
214-H	70	125	41	2160	2025	19.95
215-H	75	130	41	2245	2090	22.85
204-H	20	52	21	530	520	6.25
305-H	25	62	23	770	630	7.45
306-H	30	72	27	1035	750	8.60
307-H	35	80	31	1365	970	10.10
308-H	40	90	34	1715	1155	12.65
309-H	45	100	38	1980	1410	15.40
310-H	50	110	41	2530	1585	17.00
311-H	55	120	45	2860	1925	19.40
312-H	60	130	49	3300	2310	22.85
313-H	65	140	53	3850	2695	26.40
314-H	70	150	57	4180	3080	31.30

THE G WILLIAM COMPANY

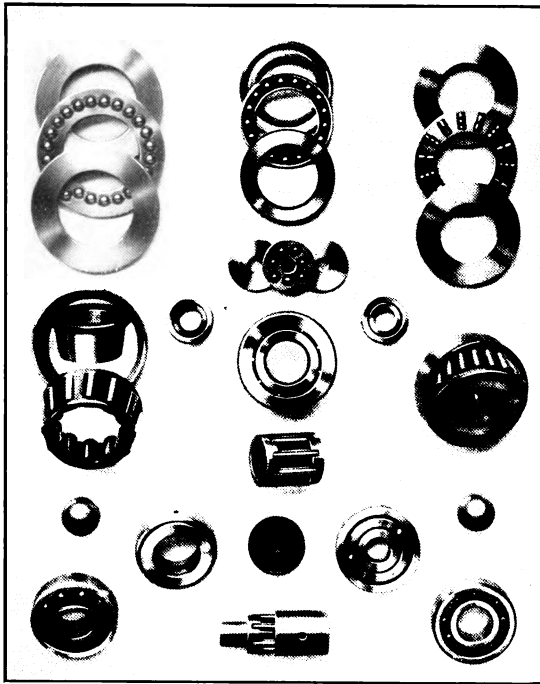
THE NEW DEPARTURE SERVICE STATION

NEW YORK: 253 WEST 58TH ST., (AT BROADWAY)

PHONE: COLUMBUS 8356

PHILADELPHIA: 1314 ARCH ST., PHONE WALNUT 3497

ENGINEERS AND SPECIALISTS IN BEARINGS



TYPES OF BEARINGS IN STOCK OR TO ORDER

Annular Ball Bearings

Ball Thrust Bearings

Journal Roller Bearings

Pressed Steel Bearings

Roller Thrust Bearings

Taper Roller Bearings

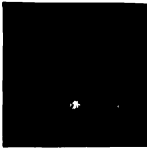
Thrust Bearing Retainers

Brass, Bronze, Steel Balls

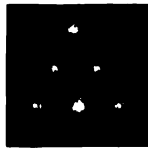
CALL, PHONE OR WRITE

ATLAS BALL COMPANY PHILADELPHIA

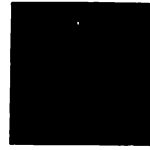
ATLAS STEEL BALLS



Rough Ground



Smooth Ground



Finished Balls

The process by which ATLAS BALLS are made is more highly perfected than any other known to the steel ball industry.

It is essentially a process which leaves nothing to speculation. Every step from the purchase of steel, to the packing of the balls in their boxes, is circumscribed by accuracy.

The balls go through a process which includes forging, three stages of grinding, annealing, hardening and polishing, the nature of which produces balls of uniform cross-section, *hard clear through*, and absolutely accurate within .0001 of an inch. *This is guaranteed!*

For positive and easy identification all ATLAS BALLS are packed in oil, in sealed cartons, as shown, and each bears a label giving the exact size and the number of balls in the box.

The fact that more ATLAS BALLS are used in more high grade bearings than balls of other manufacture—which cannot be made by the ATLAS process because of patent protection—is conclusive evidence of their superiority and economy.

Illustrated printed matter, and full information, on request.



These ATLAS BALL boxes are your guarantee of *hardness clear through* and accuracy within .0001 of an inch. They positively identify ATLAS BALLS.

THE BUNTING BRASS & BRONZE CO.

729 SPENCER ST., TOLEDO, OHIO

BUNTING'S MACHINED BRONZE BUSHINGS AND BEARINGS

We are in a position to offer Bronze Bushings and Bearings Completely Machined and ready for Assembly at a saving in cost of from 25% to 100% over the cost of the castings and machine work.

We have demonstrated the above fact to more than 250 concerns, whom we supply with our material, and who are in most cases the largest and most prominent companies manufacturing Machine Tools, Automobiles, Automobile Parts, Engines, Agricultural Machinery, Etc.

These users are ready to testify that we are able to produce these parts in quantity, machined complete, far more cheaply and of a much better grade of material and workmanship than they could do it themselves.

We operate our own bronze foundry and use specially designed semi-automatic machinery in the manufacture of our product.

Bunting Standard Phosphor Bearing Bronze used in all Bushings, unless otherwise specified, in which case special price applies. Bunting Bearing Metal is the highest grade possible to secure.

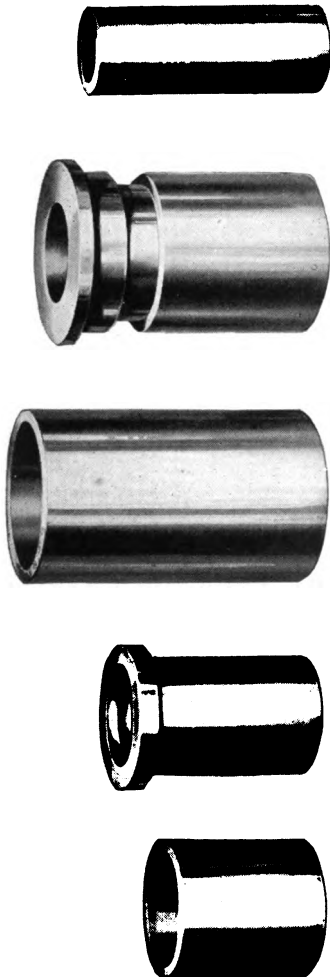
We require NO PATTERNS OR TOOLS.

Our new Bronze Bushing Catalog, which we call Price List "M," is a valuable *reference book*, listing 1248 Standard size Bushings or Bearings with manufacturers' net prices in quantities of 100 to 1000. If you use Bushings or Bearings this price list should, by all means, be consulted before placing your orders. Gladly sent upon request.

If you should want a bushing that is not listed, we can make it. (Send specifications). We use your own composition if you prefer.

We quote prices from Blue Prints, Samples or send us dimensions.

Directions for Ordering: Dimensions—All inside and outside dimensions must be furnished in decimals, thus, 1.503". Diameter dimensions guaranteed to be within .001". All dimensions given in common fractions will be held to commercial accuracy, viz., .01".



The above Illustration Shows Several Styles of our Bronze Bushings

A. ALLAN & SON

494 GREENWICH STREET

NEW YORK

**INVENTORS AND SOLE MANUFACTURERS OF
ALLAN RED METAL AND ALLAN BRONZE**



ALLAN BRONZE

A lead-copper-tin bearing alloy with high lead and high tin content. A close grained homogeneous bearing bronze, that will give a long period of service with small loss of metal by wear, that will minimize friction and that will not have a tendency to heat rapidly, causing the bearing to hug and tear the shaft. A bearing bronze for heavy duty service.

ALLAN RED METAL

A lead-copper babbitt, that will give efficiency at temperatures that would at once destroy any white babbitt metal. A bearing alloy adapted for turbine shaft packings, piston rod and valve steam packings, turbine, motor, crank pin and cross head bearings, and for facing high pressure pistons where superheated steam is used at temperatures up to 150 pounds pressure and 200° superheat.

PISTON ROD AND VALVE STEM PACKINGS

Allan Red Metal ring castings for piston rod and valve stem packings, will overcome your packing troubles where superheated steam is used. (We do not manufacture stuffing box packings, we supply ring castings for same.)

VALVE DISCS

Allan Metal Globe Valve Discs are metallic and will outlast many vulcanized rubber discs. Excellently adapted for superheated steam service.

BEARINGS AND BUSHINGS

Allan Red Metal will not under the most severe service conditions or neglect in oiling run out of a bearing. It cannot hug, stick to, cut or scar the pin or shaft. In service the bearing takes on a highly burnished copper surface which reduces the friction and wear to a minimum. These are a few of its distinctive features which make it the babbitt metal that can be depended upon at a critical time. Allan Red Metal cannot be melted in a ladle like white babbitt metal, but must be run down in a graphite crucible like brass. We babbitt bearings at our works for customers who have not got the facilities of a foundry.

We carry in stock bushing patterns for all I. D. and O. D. in lengths 6", 12" and 18", and supply bushings of Allan Red Metal and Allan Bearing Bronze at short notice.

A. ALLAN & SON

494 GREENWICH STREET
NEW YORK

**INVENTORS AND SOLE MANUFACTURERS OF
ALLAN RED METAL AND ALLAN BRONZE**

FACING HIGH AND LOW PRESSURE PISTONS

Millions of pounds of Allan Red Metal have been used for facing H. & L. pressure pistons, with the result that to-day Allan Metal faced pistons are acknowledged by engineers as the most advanced design in piston construction. It reduces the friction and wear, overcomes scoring of cylinders, and keeps same in a smooth and polished condition. It makes the bull ring last the life of the engine and eliminates cylinder reboring.



Our booklet, "The Heart of the Engine—The Seat of Power," is a treatise on piston design and covers in detail the application of Allan Red Metal to pistons.

We carry in stock tons of segment castings of all sizes for pistons from 10" to 110" diameter.

ECONOMY

You cannot expect to attain a high standard of economy in your plant if you consume a large percentage of the power produced in overcoming excessive friction in the reciprocating parts of your engines and mills any more than poor piston valve regulation.

You cannot afford to overlook the use of materials or advanced designs that tend to minimize friction, wear and the possibility of shut-down, thereby showing an efficiency, by the economy in fuel consumption, reduction in plant's maintenance cost and bearing up-keep.

OUR GUARANTEE

Bearing alloys sold by us are expected to give the efficiency we claim and on which we receive your orders. If they fail, return the scrap at our expense. We will refund your money.

All our bearing alloys are made from the best brands of Virgin metals, under able mechanical and metallurgical supervision, to maintain at all times the quality and uniformity of our alloys.

For twenty-two years we have been exclusively bearing metal specialists.

BOSTON BELTING COMPANY

84 LINDEN PARK ST., BOSTON

100-102 Reade St. 90 Pearl St. 172 W. Randolph St. 55 First St. 105 First St.
NEW YORK BUFFALO CHICAGO SAN FRANCISCO PORTLAND, OREGON

MECHANICAL RUBBER GOODS: BELTING, HOSE, PACKING, ETC.

TRANSMISSION BELTING

Rubber Belting is perfectly uniform in width and thickness. It is not readily affected by heat or cold and is well adapted for use in damp and wet places. It is strong, durable, grips the pulleys closely and does not slip.



Brands—Excelsior Red Frictioned, Imperial stitched, Elmwood, Boston, Niagara, Trimount, Universal, Special Excelsior.

Adapted for all conditions of service; made from qualities and weaves of duck and grades of rubber which assure maximum service and economy.

Gutta-Balata Belting; a high-grade textile belt, adapted for power transmission, also for conveying; so constructed that belts four-ply and heavier have absolutely seamless faces, and either side can be run next the pulleys; not injuriously affected by moderate quantities of oil or grease.

CONVEYOR BELTING

Made all widths and thicknesses, with regular rubber cover, or extra thick rubber cover on one or both sides, and reinforced edges; adapted for use on straight or troughing pulleys, for carrying coal, ores, grain, gravel, sand and other materials.

HOSE

Rubber, for water, steam, gas, air, suction, oil and fire protection.

Roxbro Braided Hose, which is furnished in continuous lengths up to 500 feet, is especially recommended for pneumatic use.

Cotton Hose, rubber-lined, furnished in light and heavy single fabrics and medium and heavy jacket fabrics for all kinds of fire protection equipment.

Unlined Linen Hose, American Underwriters; supplied in all sizes and lengths, for interior fire protection equipment. Approved by all insurance interests.

PACKINGS; sheet form, for flanges and joints; adapted for all conditions of service. Piston and valve rod packings, round, square and spiral; for hot and cold water and hydraulic purposes.

RUBBER PUMP VALVES; made in all shapes and sizes for different styles of pumps and various service conditions.

RUBBER COVERED ROLLERS. New Rollers Complete. Rollers Re-covered.

High-grade coverings, made from selected gums; adapted for paper and textile mill uses, tanneries, tobacco factories, and every purpose for which rubber-covered rollers are used.



THE B. F. GOODRICH COMPANY

AKRON, OHIO

Offices in all principal cities

MANUFACTURERS OF MECHANICAL RUBBER GOODS, TIRES, ETC.

BELTING

TRANSMISSION BELTS—Main drivers require the best quality. Weight and weave of duck, amount of stretch in service, and character of cover should be considered. We recommend the following grades:

"Pinnacle"—frictioned-surface, maximum strength, extreme quality.

"Titanic"—regular covered, extra strong and long lasting for hard service.

"Pilgrim"—regular covered, heavy duck, good friction and cover; for general service.

On small pulleys operating at high speed we recommend:

"Marathon"—a friction surface belt of highest quality, built on special woven light, flexible duck.

Light drives, such as agricultural service, are well met by **"Rob Roy,"** built on medium duck, and **"Signal,"** built on light weight duck.

CONVEYOR BELTS for conveying ore, coal, rock, etc., call for special qualities in the belt that have taken years of practical experience to develop. A duck of maximum strength and extreme flexibility, a strong friction, a wear-resisting cover, which will remain pliable and an edge armored against chafing are all required. We offer the following grades:

"Longlife"—for severe service, where extreme wear is desired.

"Maxecon"—for ordinary service; low priced, but reliable and serviceable.

For handling grain, packages, etc., there is so little abrasion and the conditions are so dry that belts of ordinary construction can be used. We recommend our

"Grainbelt"—medium weight duck, cover of usual thickness. Four plies is common practice for horizontal conveyors. For bucket elevator belt service heavier plies are required—six plies standard. If heavier duck desired, we recommend **"Pilgrim"** grade.

"Cossette" Belt—one of exceptionally high quality throughout, for handling cossettes in beet sugar factories.

"Whitecover" Canning Belt, special white sanitary cover for food canning factories.

Grader Belt—Recommend **"Maxecon"** with 1/32" or 1/16" top cover.

ELEVATOR BELTS for mines and quarries require a duck of extra strength, quality and weight to resist the tensile strains and the action of the bucket bolts. We use a special, tightly woven duck and recommend the following belts built on it:

"Goodrich" Elevator Belt—special high grade for most severe service, especially recommended for mining field.

"Akron"—high grade, designed for hard duty.

"Sterling" Stitched—slightly lower grade, for general conditions.

"GOODRICH AXLE LIGHTING" belt meets the severest service known—that of the electric train lighting from the car axle.

POLISHING BELTS—Sometimes called Emery Belts; built on especially strong fabric with high quality, tough friction.

We are also prepared to furnish Magnetic Take-Off Belt, Separator Belts, etc.



JEWELL BELTING COMPANY

Established 1848

Main Office, Belt Factory and Chrome Leather Tannery

HARTFORD, CONN.

OAK LEATHER TANNERY
ROME, GA.

WESTERN BRANCH
167 W. Lake St., CHICAGO

LEATHER BELTING AND LACING

Our Tannery is located in the heart of the best Oak Bark producing section of the country. Our hides are all selected for the sole purpose of making them into Belting leather. Our plants are equipped with the most modern up-to-date machinery and appliances; especially adapted to the production of high-grade leather and belting at a minimum cost. We make a grade of belt suitable for any class of work from the heaviest to the lightest. Our grades follow:

JEWELL SPECIAL PLANER BELT

Made from center cuts of specially selected heaviest oak bark tanned hides; leather specially treated for the work it has to do; perfectly balanced; has a maximum of strength and a minimum of stretch and is fully guaranteed.

JEWELL EXTRA BELT

Made of center cuts of heavy oak tanned belting butts from which all shoulder and flank stock has been removed; guaranteed to weigh an average of not less than 16 ounces to the square foot; especially recommended for heavy duty and slow speeds.

JEWELL HARTFORD BELT

Made of the same kind and quality of leather as the Jewell Extra, like it in all respects except thickness or weight; guaranteed to weigh an average of not less than 14 ounces to the square foot; especially recommended for small pulleys and high speeds.

JEWELL DYNAMO BELT

Always made in doubles from specially selected pliable oak tanned leather; perfectly balanced and constructed with special reference to the work it would have to do on electrical and other machinery having small pulleys running at high speeds.

All the above grades are fully guaranteed as to every detail of material and workmanship. All are put together with waterproof cement and oil dressed at special prices upon special request.

JEWELL DIVER BELT

Made of the very best selected heavy oak tanned leather, put together with waterproof cement and heavily oil dressed; specially recommended for heavy duty and where there is more or less dampness and steam.

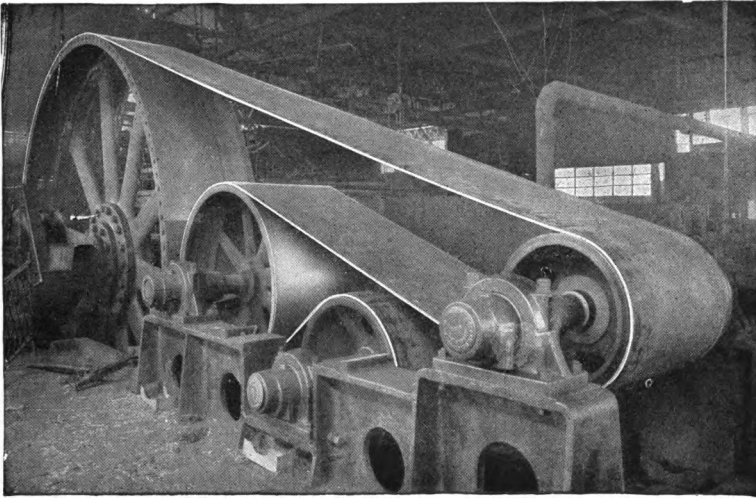
JEWELL ROUND BELTING

We are the largest manufacturers of Round Belting in the world. It is used on sewing machines and all other machinery where a grooved pulley is required; for bell and register cord in street cars. Our production is over ten million feet annually. It is made in all sizes from $\frac{1}{8}$ inch to $\frac{7}{8}$ inch.

JEWELL BELTING COMPANY

JEWELL CHROME LEATHER

Undoubtedly the most remarkable leather product of the Twentieth Century; tanned by a special process which produces a leather that isn't injured by the action of hot or cold water, steam, oil, gas and many acids.



48-in. 3-ply Chrome Belt transmitting up to 1900 horse power, at plant of Atlanta Steel Co., Atlanta, Ga. This Belt has already lasted four times as long as the best oak tanned belt ever used on this drive before.

JEWELL CHROME BELT

The Jewell Chrome leather put together with a waterproof cement making a belt that is not affected by steam, gas, water, etc., as above stated, and in addition a belt that has the greatest possible pliability combined with the greatest tensile strength and the least tendency to stretch. It will slip less on the pulleys, transmit more power per inch of width with less loss of power than any belt known. The illustration herewith is a fair sample of what it will do.

BLACK JEWELL BELT LACING

Made both in sides and cut lace; the strongest and most economical Belt Lacing known.

KING PHILIP BELT LACING

Made both in sides and cut lace. There is no better lacing made than King Philip.

OTHER JEWELL PRODUCTS

Other Jewell products are Agricultural Belting, Binder Straps, Trunk Straps, Skate Straps, Fan Belts, Automobile Leathers such as Brake Bands, Clutch Facings, Straps, etc., Polishing Leathers, and

POTTER'S PATENT BELT HOOKS

THE GRATON & KNIGHT MFG. CO.

WORCESTER, MASSACHUSETTS, U. S. A.

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Boston, Mass.
Chicago, Ill.
Cleveland, O.

Detroit, Mich.
Fall River, Mass.
Kansas City, Mo.
Minneapolis, Minn.

New York, N. Y.
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Portland, Ore.
St. Louis, Mo.
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Seattle, Wash.

SELLING AGENTS •

The Graton & Knight Mfg. Co. of Texas, Dallas, Texas.
The Graton & Knight Mfg. Co. of Wis., Milwaukee, Wis.

OAK LEATHER TANNERS AND BELT MAKERS

BELTING

"SPARTAN"—a first quality belt made from leather of a special tannage, unusually pliable with great tensile strength, guaranteed to resist exposure to water, steam, oil, gas or acid fumes, or to dry heat as high as 400° F.

"SPECIAL PLANER"—a first quality waterproof belt made from extra heavy oak tanned center stock in single thickness up to 4 in. in width—particularly adapted for heavy work.

"NEPTUNE"—first quality single, double and 3-ply waterproof leather belting made from the choicest oak tanned center stock leather.

"HEART"—first quality, heavy, single, double, and 3-ply leather belting made from the choicest oak tanned center stock leather.

"GKKNIGHT"—first quality, medium weight, single, double, and 3-ply leather belting made from the same high quality center stock as the Heart brand, simply a trifle lighter in weight.

"GKKNIGHT DYNAMO"—first quality, light weight leather belting made from oak tanned center stock leather. Furnished principally in doubles, and constructed especially for use on high speed machinery such as motors, fans, blowers, etc.

"EXTRA SHORT LAP"—made from heavy side stock leather in single and double thickness only, and not over 6 in. in width. Used successfully where the work does not require strictly first quality belting.

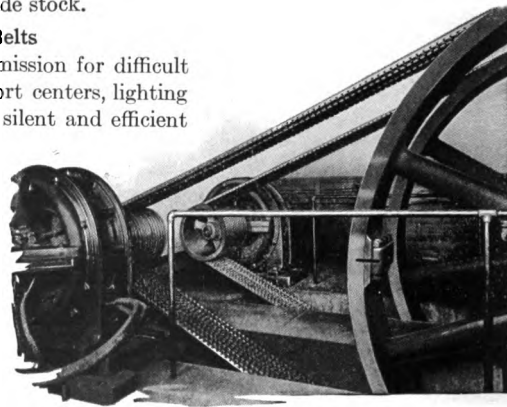
"PRYZOAK"—differs from the Extra Short Lap in weight only; it is somewhat lighter, made in both singles and doubles, but not exceeding 6 in. in width.

"CYLINDER BELT"—made in both singles and doubles from selected, well stretched shoulders, or thin side stock.

Spartan "V" Belts

An efficient means of transmission for difficult drives—motor drives with short centers, lighting systems, or any place where a silent and efficient drive is required. The thickness and construction of Spartan "V" Belts vary to meet the requirements of each application.

Our Engineering Department will gladly investigate or design any drive upon request. Let us consult with you.



Two 12 Strand 1¼" 6-ply Spartan "V" Belt Drives each Transmitting 150 Horse Power

OTHER G & K PRODUCTS

Round Belting
Lace Leather

Washers
Straps

Leather Packings
Automobile Leathers, etc.

The complete line of G & K products represents superior quality and honest value.

MAIN BELTING COMPANY

PHILADELPHIA
PITTSBURGH

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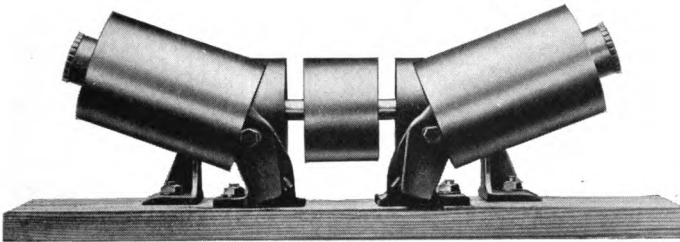
NEW YORK
BIRMINGHAM

MONTREAL

Represented in Canada by
MAIN BELTING CO. OF CANADA, Ltd.

TORONTO

**MANUFACTURERS AND ENGINEERS: SOLE MANUFACTURERS OF
LEVIATHAN AND ANACONDA BELTING, LEVIATHAN ADJUSTABLE
CONVEYOR ROLLERS**



Leviathan Conveyor Rollers

LEVIATHAN CONVEYOR ROLLERS are adjustable with a maximum angle of 20°. They have no groove or opening at the troughing point, the rims of the troughing pulleys are reinforced and the principal parts are interchangeable, being the same for all sizes.



LEVIATHAN has been on the market for over thirty-three years. For general belt service as it occurs in the large majority of plants, LEVIATHAN has proved its efficiency. It has greater traction than leather, is more durable than rubber, more reliable than either. Under any circumstances, except those known as "belt-killing," it will give most economical service.

ANACONDA is made of the same canvas as LEVIATHAN, but treated with another composition, which makes it water and heat proof, and highly resistive to acidity.

LEVIATHAN and ANACONDA are used for Elevating, Transmitting, Conveying, according to the conditions stated above. They stretch less, and need less take-up than any other belts.

If in doubt as to which belt is needed, write our nearest office.

Our Engineering Department is at your service to help you meet the conditions you have. This puts you under no obligations. We want your orders, but we expect them only on squarely earning your confidence without favor.

THE ROSSENDALE-REDDAWAY BELTING & HOSE CO.

NEWARK, N. J., U. S. A.

MANUFACTURERS OF "CAMEL" BRAND, STITCHED CANVAS, "BLACK
BIRD" SOLID WOVEN, AND BIRD'S BULL'S-EYE BELTING

"CAMEL HAIR" BELTING



Reg. Trade Mark

For Power Transmission.

This belt is remarkable for its great strength (almost twice that of the leather belting), long life, small slippage, minimum stretching, straight true running, and for the fact that it is less affected by dampness or acid fumes than any other kind of belting. This belting is also sold under a guarantee that it will give longer, better service than any other style of belting running under the same conditions.

BIRD'S BULL'S-EYE BELTING



Reg. Trade Mark

For Power Transmission and for Conveying.

SOLID WOVEN BELTING

"Black Bird"

Reg. Trade Mark

For Power Transmission and for Conveying.

STITCHED CANVAS BELTING

"Sphinx" Brand and lighter weights for all purposes.

BRAKE BAND LININGS

JOHN A. ROEBLING'S SONS CO.

TRENTON, N. J.

WIRE ROPE OF ALL KINDS



We manufacture and keep in stock at our works at Trenton and at warehouses at agencies and branches in large cities wire rope, made from Iron, Cast Steel, Extra Strong Cast Steel, Plough Steel and Blue Center Steel.

We give below tables of strengths, etc., for the standard constructions of BLUE CENTER STEEL ROPE. The rope is also furnished with 6 strands of 37 wires each and with 8 strands of 19 wires each.

This rope is recommended as the best to use where extreme conditions tend to bring extraordinarily severe stresses, and is particularly well adapted to resist abrasion.

The hemp center of this rope is colored blue to distinguish it from other wire ropes.

BLUE CENTER STEEL HOISTING ROPE

Composed of 6 Strands and a Hemp Center, 19 Wires to the Strand

Trade Number	Diameter in inches	Approx. circumf. in inches	Approx. weight per foot	Approx. strength in tons of 2000 lbs.	Proper working load in tons of 2000 lbs.	Diam. of drum or sheave in feet advised
00	2 3/4	8 5/8	11.95	315	63	11
0	2 1/2	7 7/8	9.85	263	53	10
1	2 1/4	7 1/8	8	210	42	9
2	2	6 1/4	6.30	166	33	8
2 1/2	1 7/8	5 3/4	5.55	150	30	8
3	1 3/4	5 1/2	4.85	133	27	7
4	1 3/8	5	4.15	110	22	6 1/2
5	1 1/2	4 3/4	3.55	98	20	6
5 1/2	1 3/8	4 1/4	3	84	17	5 1/2
6	1 1/4	4	2.45	69	14	5
7	1 1/8	3 1/2	2	56	11	4 1/2
8	1	3	1.58	45	9	4
9	7/8	2 3/4	1.20	35	7	3 1/2
10	3/4	2 1/4	.89	26.3	5.3	3
10 1/4	9/8	2	.62	19	3.8	2 1/2
10 1/2	1 1/8	1 3/4	.50	14.5	2.9	2 1/4
10 3/4	1 1/2	1 1/2	.39	12.1	2.4	2
10a	1 1/8	1 1/4	.30	9.4	1.9	1 3/4
10b	3/8	1 1/8	.22	6.75	1.35	1 1/2
10c	1/8	1	.15	4.50	.9	1 1/4
10d	1/4	3/4	.10	3.15	.63	1

BLUE CENTER STEEL ROPE

For Haulages and Transmissions. 6 Strands and a Hemp Center, 7 Wires to the Strand

11	1 1/2	4 3/4	3.55	90	18	11
12	1 3/8	4 1/4	3	79	16	10
13	1 1/4	4	2.45	67	13	9
14	1 1/8	3 1/2	2	52	10	8
15	1	3	1.58	42	8.4	7
16	7/8	2 3/4	1.20	33	6.6	6
17	3/4	2 1/4	.89	25	5	5
18	11/16	2 1/8	.75	20	4	4 3/4
19	5/8	2	.62	17 1/2	3.5	4 1/2
20	1/2	1 3/4	.50	13	2.6	4
21	1/2	1 1/2	.39	11	2.2	3 1/2
22	1/4	1 1/4	.30	7 3/4	1.5	3
23	3/8	1 1/8	.22	6 1/2	1.3	2 1/2

A copy of our catalogue, giving information about other wire ropes, and wire rope fastenings will be mailed on application.



A. LESCHEN & SONS ROPE COMPANY

Established 1857

ST. LOUIS, MO.

NEW YORK

CHICAGO

DENVER

SALT LAKE

SAN FRANCISCO

**WIRE ROPE FOR ALL PURPOSES
AERIAL WIRE ROPE TRAMWAYS IN VARIOUS SYSTEMS**

HERCULES WIRE ROPE

(TRADE MARK REGISTERED)

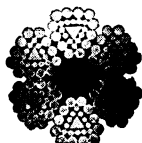
Hercules Wire Rope is made from that class of material which combines strength, elasticity, toughness and flexibility in correct proportions for maximum wire rope efficiency. It is made in various constructions to meet the working conditions of all wire rope usages of an exacting nature. It has one red strand for identification purposes.

We also manufacture high grade Plow Steel, Cast Steel, Special Steel, Iron and Galvanized Steel and Iron wire ropes.

Recognizing the importance of correct construction, we make wire ropes in all the usual types as well as special constructions for individual conditions. Among such ropes are:

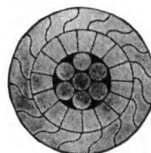
PATENT FLATTENED STRAND CONSTRUCTION

Patent Flattened Strand rope is so made that the outer wires conform to a circle, so instead of only one wire in each strand being exposed to frictional wear there are from two to six, depending upon the style of construction. This distribution of wear allows smaller wires to be used, which results in extreme flexibility.



Cross Section
Patent Flattened
Strand
Hoisting Rope

This construction also affords greater strength, as the shape of the strands permits them to fit snugly together, thereby allowing more metal to be used in a given diameter.



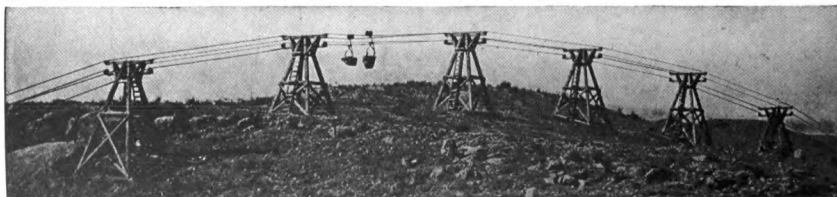
Cross Section
Locked Coil
Cable
for Tramways

LOCKED COIL CONSTRUCTION

For Heavy Track Cable Service

This type of rope consists of a succession of layers or coils, the surface layer being interlocking. The compactness of Locked Coil rope provides great strength and presents maximum resistance to crushing tendencies. Its smooth bearing surface reduces wear and minimizes vibration.

Descriptive catalogs gladly furnished upon request



AMBURSEN COMPANY

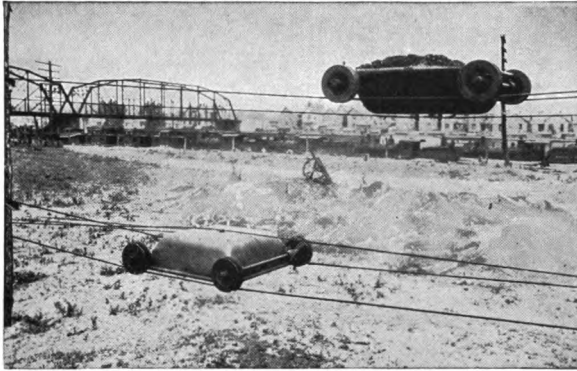
TRAMWAY DEPARTMENT

(Lessees and Sole Licensees of the Consolidated Tramway Company)

ENGINEERING AND SALES OFFICE

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MANUFACTURERS OF THE LAWSON LOOP-LINE TRAMWAYS, FLEXIBLE CONVEYORS, CABLE-TRACTION LOCOMOTIVES, ETC.



Going Full, Returning Empty

THE LAWSON AUTOMATIC TRAMWAY

Exemplifies the last word in the SCIENCE OF SHORT HAUL. It does everything better than any other tramway; many things which it does can be done by no other tramway.

It is semi-automatic in loading.

It is fully automatic in discharging.

It is operated by one man at the loader only.

It can be extended to any number of miles by relay sections.

It is indifferent to grade or curvature and follows any profile.

It discharges its load at regular intervals and in uniform amounts.

By an ingenious device the car in dumping clears itself of every kind of material, however soft or sticky.

If required, it transports in either direction, loading and dumping at either end of the route.

Unlike every other tramway its cable wear and other maintenance is almost nominal: this statement is hard to believe, but is, nevertheless, a fact.

Its capacity is anything from 10 to 100 tons per hour.

It handles ore, coal, culm or slack, crushed stone, gravel, sand, clay, cross-ties, tan bark, logs, lumber, staves, merchandise, boxes, cotton bales, sugar-cane, or any other material—including people.

It takes a minimum of power to operate it.

It has handled ore for a year, including loading, transporting, and dumping, for an average of 3c. per ton taken from the books.

Being portable and in small units, it can be removed, changed in length, relocated and rebuilt as often as desired;—hence a contractor makes it a part of his plant.

Notwithstanding all this IT IS THE LOWEST IN FIRST COST OF ANY TRAMWAY ON THE MARKET.

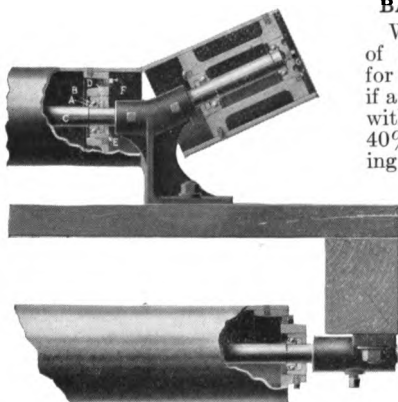
Send for our various Bulletins which are fully illustrated. After reading them tell us your problem. As Short-Haul Engineers, we will then recommend the proper lay-out and tell you what it will cost to install and to operate.

THE CONVEYING WEIGHER CO.

90 WEST STREET, NEW YORK, N. Y.

AGENCIES: HERBERT AINSWORTH, Esq., The Corner House, JOHANNESBURG, S. AFRICA.
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VICTOR M. BRASCHI MACHINERY COMPANY, MEXICO CITY, MEX.
ZIMMER CONVEYOR COMPANY, 82 Mark Lane, LONDON, E. C., ENG.
AMERICAN CONCENTRATOR COMPANY, JOPLIN, MO.
STIMPSON EQUIPMENT COMPANY, SALT LAKE CITY, UTAH.

BALL BEARING BELT CONVEYORS; CONTINUOUS, AUTOMATIC SCALES FOR BELT AND OTHER CONVEYORS; CONVEYING AND HOISTING MACHINERY; COMPLETE MATERIAL HANDLING PLANTS; TRUMP MEASURING AND MIXING MACHINES; TRUMP CONCRETE MIXERS



"Conweigh" Ball Bearing, troughing, and return idlers for belt conveyors (patents pending)

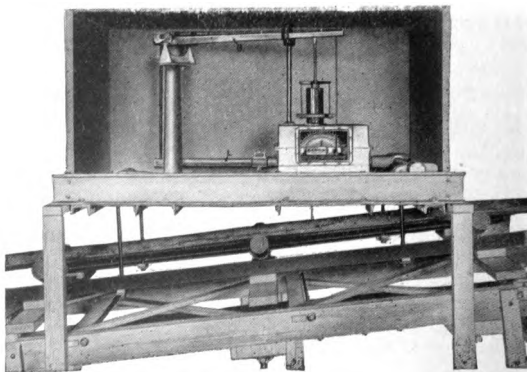
BALL BEARING BELT CONVEYORS

We illustrate herewith the construction of ball bearing troughing and return idlers for belt conveyors. It is guaranteed that if a belt conveyor running level be equipped with these idlers, there will be a saving of 40% in power required. These idlers having felt oil-retaining washers need to be lubricated only once in two years.

- A Hardened steel "Cone" fitted on turned steel shaft
- B Pressed steel "Ball Retainer"
- C Turned steel shaft, set screwed in Idler brackets
- D Oiled washer of felt or carded wool
- E Hardened steel "Plug" screwed into pulley hub
- F Brass plug for lubrication
- G Lock screw to prevent hardened plug from turning

THE MERRICK CONVEYING WEIGHER

This device records the weight of material handled on belt conveyors, bucket conveyor, cable railways and overhead trolleys or telfers. The weigher consists of a pair of weighing levers and a steelyard of special design so that a short section of the conveyor can be suspended from the weighing levers. The extreme end of the steelyard is connected with a totalizing mechanical integrator which derives its other factor from the travel of the conveyor by means of suitable gearing from a bend pulley on the return belt, or a sprocket wheel if on a bucket conveyor. This integrator continuously totalizes the product of two quantities, one proportional to the weight of material suspended and the other to the travel of this material. The result therefore represents the total weight of material and is plainly indicated by a register.



View of Conveyor Weigher. Front Sheet of Casing Removed

H. W. CALDWELL & SON COMPANY

CHICAGO, ILL.

17TH ST. & WESTERN AVE.

EASTERN OFFICE

50 Church St., NEW YORK CITY

ELEVATING, CONVEYING AND POWER TRANSMITTING MACHINERY

MACHINERY FOR HANDLING MATERIAL IN BULK OR PACKAGES



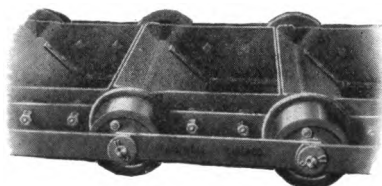
HELICOID "CONVEYORS"

Sole manufacturers of HELICOIDSCREW CONVEYOR made of one continuous strip

of metal without laps or rivets. Mounted on standard and extra heavy pipe or solid shafts.

PAN, APRON AND BELT CONVEYORS

Each designed and built to handle the material for which it is best suited, to the best advantage. For COAL, COKE, SAND, CRUSHED STONE, GRAVEL, GRAIN, BOXES, BARRELS, etc.



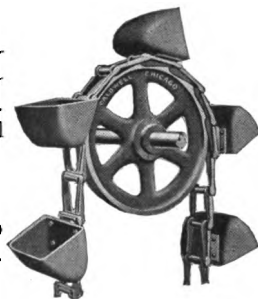
CHAINS

Standard Malleable Iron Detachable Chain. Malleable and Steel bushed chains with or without rollers. Special chains. For Conveying, Elevating or Power Transmitting Purposes.



BUCKETS

We carry a large stock of standard size and weight Salem, Seamless Steel and Malleable Buckets. We are equipped to make special Buckets of all kinds to order.



CHILLED RIM SPROCKETS

The life of the Chilled Rim sprocket is from Three to Five times that of the ordinary grey iron sprocket. Traction wheels and special sprockets furnished.



GEARS

We can furnish gears with cast Teeth Machine Molded or Machine Cut. We have the most complete equipment in the country for machine molding gears. Spurs, Bevels, Miters, Worms, Worm Wheels and Mortise Wheels.

We are prepared to furnish sheet steel conveyor troughs, hoppers, elevator casings, spouting, etc.

For a complete list of our line see a copy of our No. 38 catalogue. 800 pages of useful information to every engineer, designer, plant owner or superintendent.



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**ELEVATING AND CONVEYING MACHINERY FOR EVERY PURPOSE.
POWER TRANSMISSION MACHINERY**

Original Ewart Link-Belt, >Flint-Rim< Sprocket Wheels, Manganese Chains, Link-Belt Silent Chain Drives, Power Transmission Machinery, Pillow Blocks, Friction Clutches.

Power House Equipment: Peck Carriers, Belt Conveyors, Coal Bunkers, Telescoping Ashes Elevators.

Bridge Tramways, Locomotive and Gantry Cranes, Telphers, Electric Hoists, etc. Coal Storage Plants, Wholesale and Retail Coal Yards, Coal Tipples, Coal Washeries, Car Hauls, Crushers, Screens, Picking Tables, Chutes, etc.

Locomotive Coaling Stations, Cinder Stations, Complete Freight Handling Equipments.

Package Handling Machinery, Store Service Conveyors.

Portable Wagon and Truck Loaders, Portable Bag and Box Piling Machines.



Chains of all Types for Elevating, Conveying and Transmitting Power

Cast Iron Gearing



>Flint Rim< Sprocket
For Durability and Service



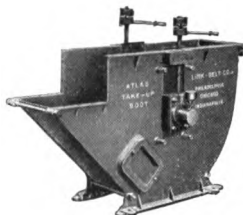
Crushers for Coal, Coke, Etc.



Friction Clutches



Malleable Iron and
Steel Buckets



Elevator Boots



Elevator Buckets



Take-Ups



Angle Boxes



Protected Screw Type Take-Ups



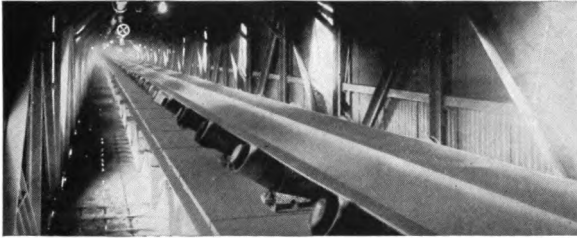
ROBINS CONVEYING BELT CO.

PARK ROW BUILDING, NEW YORK

CHICAGO OFFICE: Old Colony Building. **SAN FRANCISCO:** The Griffin Company. **SPokane:** United Iron Works. **TORONTO:** Gutta Percha & Rubber, Limited. **NEW GLASGOW,**
NOVA SCOTIA: Eastern Steel Company, Ltd.

**CONVEYING, ELEVATING, HOISTING, STORAGE, RECLAIMING AND
ORE-BEDDING MACHINERY**

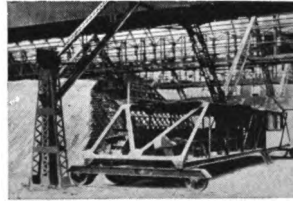
Robins Patent Conveyor Belt



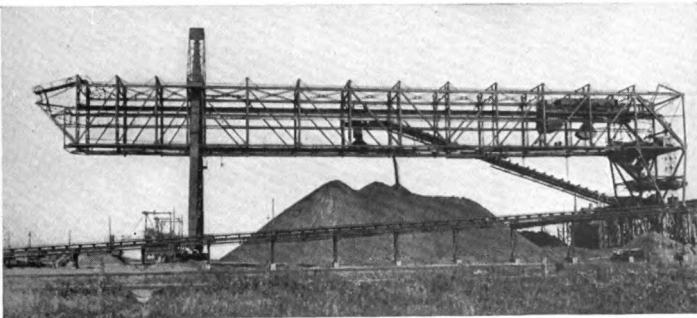
Belt Conveyors



Unloading Machinery



**Ore Bedding and Reclaiming
Machinery**



Storage and Reclaiming Machinery

Write for a set of our bulletins.

Elevating, Conveying and Power Transmission Machinery

WELLER MANUFACTURING CO.

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ELEVATING, CONVEYING AND POWER TRANSMITTING MACHINERY

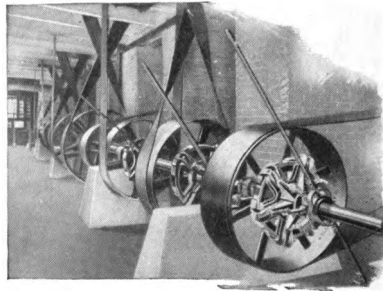
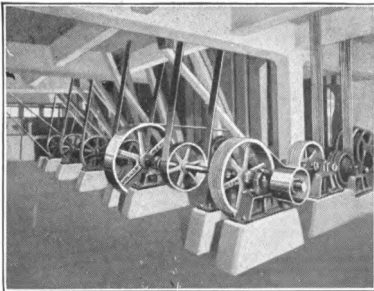
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Fertilizer and Phosphate Mills,
Grain Elevators and Flour Mills,
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Starch and Glucose Factories,
Tanneries, Brick Yards, Glass Plants,
Canneries, Paper Mills, etc.

Every member of The American Society of Mechanical Engineers should have our Catalogues:

N-40 General Catalogue on Elevating, Conveying and Power Transmitting Machinery.

N-27 Containing valuable data and information on Friction Clutches.

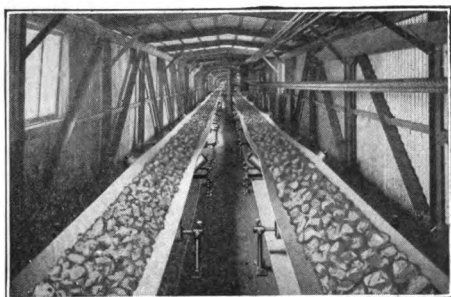


HEAVY LINE SHAFT EQUIPMENTS

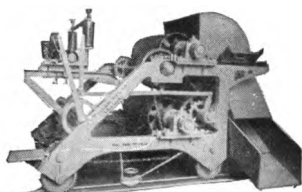
Mounted on Iron Floor Stands

Every Pulley with Friction Clutch

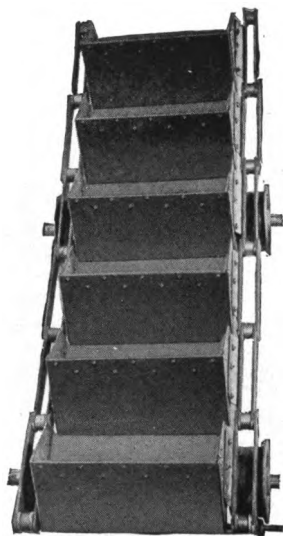
WELLER MANUFACTURING CO.



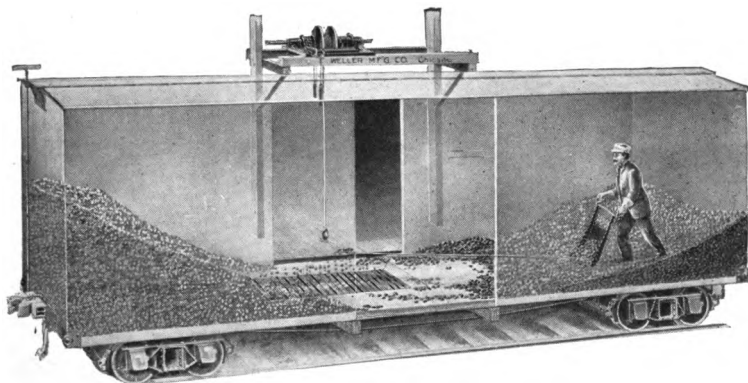
BELT CONVEYORS, 10'' to 60'' wide.



HEAVY DUTY BELT TRIPPERS

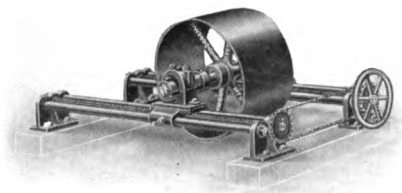


HEAVY BUCKET ELEVATORS
Up to 84'' width and 36'' pitch.!



AUTOMATIC POWER SHOVELS

For unloading coal, ore, clay, sand, salt, cement, grain and other loose material.

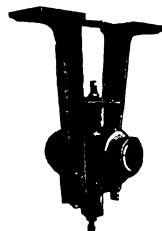


BELT TIGHTENERS



PILLOW BLOCKS

Adjustable Ball and
Socket Drop Hangers
and Pillow Blocks.

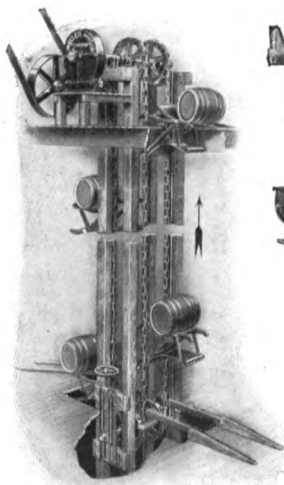


HANGERS

(Continued on next page)

(Continued from preceding pages)

WELLER MANUFACTURING CO. CHICAGO



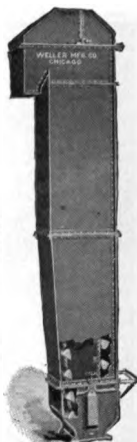
BARREL OR SACK ELEVATOR
Elevates and lowers goods at
same time automatically delivering
on either up or down run.



COLD-ROLLED SCREW CONVEYOR

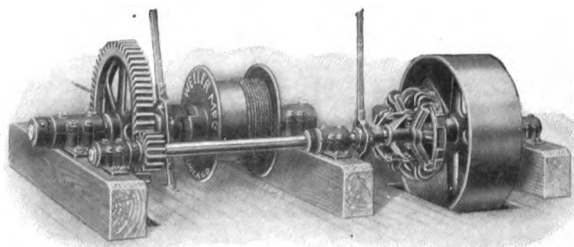


STEEL CONVEYOR BOXES

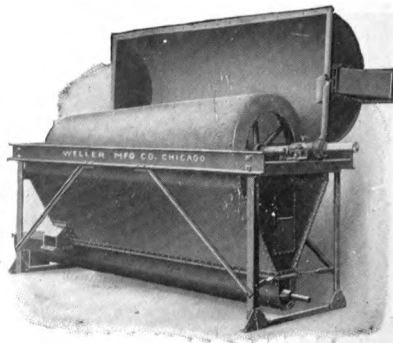
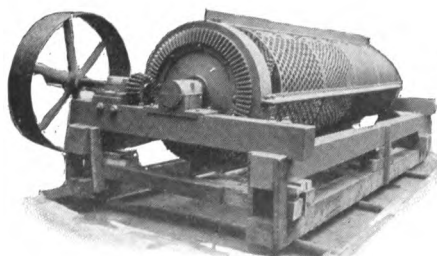


**ELEVATOR
CASINGS**
Of any design to
suit any require-
ments.

WELLER-MADE



CAR PULLERS
For handling from 1 to 50 loaded cars.



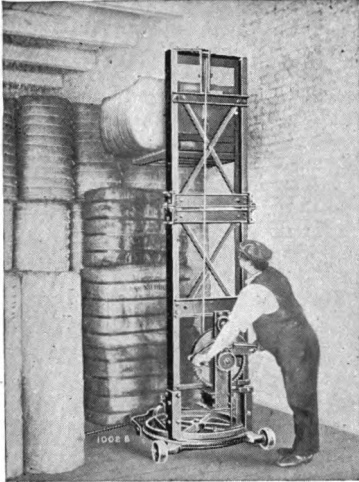
REVOLVING SCREENS, OPEN OR ENCLOSED

N. Y. REVOLVING PORTABLE ELEVATOR COMPANY

344-352 GARFIELD AVE., JERSEY CITY, N. J.

**MANUFACTURERS OF THE "REVOLVATOR" PORTABLE ELEVATORS,
TIERING MACHINES, CASE LIFTERS, ETC.**

THE "REVOLVATOR"
REG. U. S. PAT. OFF.



163

A REVOLVATOR is a portable elevator, tiering machine, case piler, stacker or lift. It consists of a *revolving base*, two uprights or elevator guides, and an elevating platform, operated by a strongly built and well designed raising and lowering mechanism. The unit is mounted on strong truck and wheels equipped with floor lock.

What it Does

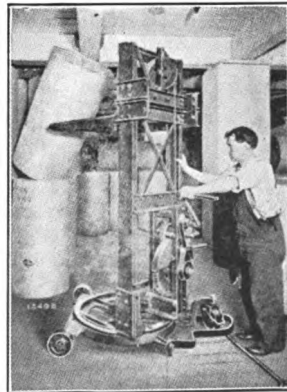
The Revolvator tiers or stacks heavy, bulky or fragile articles in any desired position, at any height and in the safest manner possible. It makes possible the use of every available cubic foot of space from floor to ceiling for storing. With a Revolvator but two, and at most three men, are required for handling the heaviest materials.

What Makes it Valuable

The big feature is the revolving base, by which the whole machine is swung around on its ball bearing center, while the lower half of the base or truck remains stationary on the floor. With the truck base anchored firmly to the floor in any position, the platform can be loaded from any desired direction and revolved about on its revolving base like a turn table to any desired position and unloaded.

It is the revolving feature that makes it possible to tier against the walls, at the end of aisles, and to elevate large, heavy articles in narrow aisles to the point to which they are to be tiered and then revolved to an advantageous position for unloading.

Revolvators and Portable Elevators of the Non-Revolving Type are made in sizes from 5 to 20 feet in height, prices \$125.00 up.



THE LAMSON COMPANY

GENERAL OFFICES

161 DEVONSHIRE STREET, BOSTON, MASS.

REPRESENTATIVES IN ALL
PRINCIPAL CITIES

WORKS

LOWELL, MASS. TORONTO, CANADA

BUILDERS OF PNEUMATIC, ELECTRICAL AND MECHANICAL CARRIER AND CONVEYOR APPARATUS

Products.—Pneumatic Tube Systems, Foot-Power Tubes, Selective Pick-Up and Sweep-Off Carriers, Automatic Tray Conveyors, Belt Conveyors, Gravity Roller Conveyors, Light Elevators and Lifts, Electric Cable and Wire Line Cash and Parcel Carriers.

Scope of Use.—Used in stores, offices, factories, libraries, banks, hotels, post offices, warehouses, freight yards, etc., for the conveyance of money, papers, merchandise, mail, and materials between departments or buildings. Over three hundred different lines of business are using Lamson equipment with profit and satisfaction.

Co-operative Service.—Architects, engineers and contractors are invited to avail themselves of Lamson experience and service. Engineers employed by this company are constantly solving complicated conveying problems and are in a position to know how to apply Lamson Service to its best advantage. Full information and plans, covering any problem to which Lamson Carriers and Conveyors may be adapted, gladly furnished without charge.

Lamson Systems.—Lamson Systems cover the following types, and with their modifications can be made to suit any problem

PNEUMATIC TUBE SYSTEMS.—Consist of tubes, stations and carriers operated by vacuum and vacuum-pressure supplied through special power equipment. System, rapid intercommunication and delivery of papers, cash, etc., to a central point by special carriers, which are placed in the tubes and automatically carried to points of delivery. This System is designed in the following types:

Independent Lines.—Consist of two tubes connecting two stations. Carriers may be sent in either direction. No lids to open or levers to manipulate at central desk. Carriers are taken from operator's hand by suction at bell mouth.

Combination (Shifting Current) Line.—Two or more out-stations may be intermittently operated by vacuum of a single ingoing line. Speed of carriers is the same as Independent Lines. All carriers are sent to central desk regardless of others in transit.

Vacuo-Pressure Start and Stop Tubes.—Built in Units. Each unit a circuit reaching from two to eight out-stations. Motor remains idle until carrier is put in tube at any sending point, when it automatically starts, and stops only after carrier arrives at destination.

LAMSON PATENT PICK-UP AND DELIVERY CARRIERS.—Traveling metal fingers or clips, which move on an endless wire, are arranged to pick up and deliver envelopes or single sheets automatically to indicated stations. (Fig. 6, also Fig. 2.)

LAMSON AUTOMATIC TRAY CONVEYORS.—Consists of a line operated by endless cable traveling about 75 feet per minute. (Fig. 3.)

BELT CONVEYOR.—Designed in conjunction with gravity chutes and elevators. Will handle boxes and packing cases, mail, etc. (Fig. 4, also Fig. 7.) For heavy loads, *Lamson Gravity Roller Conveyors* are recommended.

LIGHT ELEVATORS AND LIFTS.—Hand, hydraulic and electrically operated. Made for simple, light delivery or varied heavy service (Fig. 9.)

PARCEL AND MONEY CARRIERS.—For store and office service. Operated by push of hand for short distance: by spring, gravity, and endless overhead cable. These carriers made in a variety of styles for carrying money, merchandise, papers, etc.



Fig. 1. Lamson Patent Combination Shifting Current Vacuum Tube Construction

THE LAMSON COMPANY

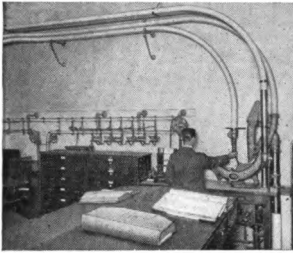


Fig. 2. Lamson Pneumatic Tubes and Pick-up System Installed in a Bank.

Pneumatic Tubes provide quick communication, save time in sending correspondence, orders, blue-prints, etc., from place to place. Each system designed to fit individual needs.



Fig. 3. Lamson Automatic Tray Conveyors.

Constantly moving metal fingers quickly pick up tools, stock, parts, documents, books and small loads of all kinds from one tray or station and deliver where desired. Made in sizes to fit special requirements. Automatic in action.



Fig. 4. Lamson Belt Conveyors in Hat Factory.

For moving merchandise of all sorts and loads of materials in raw, unfinished and finished stages, from place to place. Lamson Belt Conveyor systems designed to fit special conditions in each business.

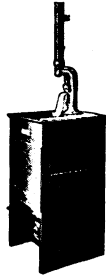


Fig. 5. Lamson Foot-Power Tubes

For lines about 200 feet in length. One pressure sends tube 75 feet on horizontal line. Foot pressure raises tube 40 to 50 feet vertically each time. Made in 2½ and 3-inch tubing.

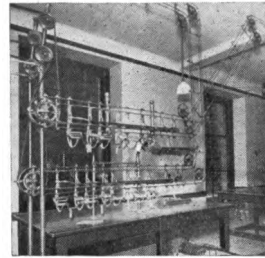


Fig. 6. Lamson Pick-Up and Delivery Carrier.

Mechanical Pick-Up Systems for handling orders, correspondence, etc., quicken office and factory routine. Deliveries of matter are made in a continuous stream. Systems arranged to run at any angle.



Fig. 7. Lamson Parcel Belt Conveyor in Department Store.

Lamson Conveyors save time in collection and delivery of packages. Enable parcels from various floors to be placed in delivery trucks and wagons in shortest time with least expense. Designed to meet needs of each individual store.

References.—A few prominent concerns using Lamson Service:

Bausch & Lomb Optical Co., Rochester, N. Y.
 Boston Public Library, Boston, Mass.
 Boston Woven Hose & Rubber Co., Cambridge, Mass.
 Carnegie Steel Co., Pittsburgh, Pa.
 County Court House, Chicago, Ill.
 Curtis Publishing Co., Philadelphia, Pa.
 Eastman Kodak Co., Rochester, N. Y.
 Elgin National Watch Co., Elgin, Ill.
 Ford Motor Co., Long Island City, N. Y.
 Guaranty Trust Co., New York, N. Y.
 Hartford Fire Insurance Co., Hartford, Conn.
 Hotel McAlpin, New York, N. Y.
 Geo. E. Keith Co., Campello, Mass.
 Lunkenheimer Co., Cincinnati, Ohio.
 Merchants National Bk., Boston, Mass.
 J. P. Morgan & Co., New York, N. Y.
 New York Telephone Co., New York, N. Y.
 New York Times, New York, N. Y.
 Otis Elevator Co., New York, N. Y.
 Peerless Motor Car Co., Cleveland, O.
 John B. Stetson Co., Philadelphia, Pa.
 Tiffany & Co., New York, N. Y.
 Union Club, New York, N. Y.
 University of Chicago, Chicago, Ill.
 Victor Talking Machine Co., Camden, N. J.
 Washburn-Crosby Co., Minneapolis, Minn.

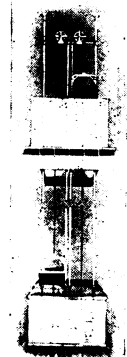


Fig. 9. Lamson Double Elevator

Types range from light hand-operated to hydraulic and electric. Made to meet any type of service required.

THE ALLIANCE MACHINE CO.

ALLIANCE, OHIO

NEW YORK

PITTSBURGH

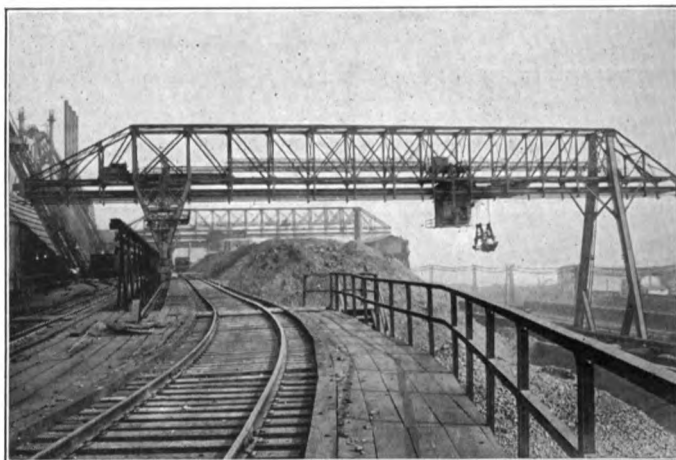
CHICAGO

BIRMINGHAM

ENGINEERS AND BUILDERS OF

ELECTRIC TRAVELING CRANES AND MACHINES OF ALL TYPES FOR ALL PURPOSES; I-BEAM HOISTS; ORE BRIDGES; ROLLING MILL AND HYDRAULIC MACHINERY, RIVETERS, STEAM HAMMERS, HEAVY PUNCHES AND SHEARS; COKE PLANT MACHINERY, SCALE CARS AND CHARGING LARRIES; COPPER CONVERTING MACHINERY

ORE BRIDGES



The above illustration shows two Ore Handling Bridges designed and furnished by us for the Pittsburgh Steel Company. These bridges are the fastest and most efficient ever placed in operation. We have recently installed practically a duplicate of these bridges for the Pennsylvania Steel Company at Steelton, Pa. Ask us for information regarding their handling capacity.

ELECTRIC TRAVELING CRANES AND MACHINES

We have built

The largest single trolley crane, 200-tons capacity.

The largest ladle crane, 175-tons capacity.

The largest stripper crane, 320-tons capacity.

The largest high type soaking pit crane, 25-tons capacity.

The largest slab charging crane.



ALFRED BOX & COMPANY

PHILADELPHIA, PA.

MANUFACTURERS OF

"THE BOX CRANE" AND "THE BOX ELECTRIC HOISTS"

ELECTRIC TRAVELING CRANES.

Built for operation on either Direct or Alternating Current. Our cranes are first-class in every respect; designs are kept modern and best practice followed. We specialize on cranes for Foundry and Machine Shop service, and have an especially designed crane for use in Power Plants.

HAND POWER TRAVELING CRANES.

Built in capacities of 500 lb. to 75-tons and of all types for operation from floor by pendant chains or ropes; from pendant winch hanging to floor, from side platform alongside of crane bridge, and from platform hanging below crane. All cranes are kept modern in design and are easy to operate.

JIB CRANES.

Built in capacities of 500 lb. to 25-tons and of all types either hand operated or motor driven. We specialize on jib cranes for Foundry and Machine Shop Service, and build especially designed Forge Shop cranes.

GRAB BUCKET OPERATING CRANES.

Built in both monorail traveling and bridge types for operation on either Direct or Alternating Current. Our grab bucket cranes have the most simple design of any on the market.

ELECTRIC HOISTS.

Built in capacities of 500 lb. to 30-tons for operation on either Direct or Alternating Current and for any service. Designs are kept modern in every respect. We specialize on monorail hoists of all capacities, as well as those of portable type. We build a special contractor's hoist (direct geared to motor) which is also extensively used by foundries as a "skull cracker," also a special motor driven cat head for pulling wagons, cars, etc.

OVER HEAD TRACK SYSTEMS.

For all services, electric systems a specialty.

CHAIN HOISTS.

I-BEAM TROLLEYS.

Catalogues on request.

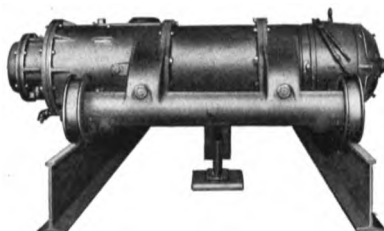


SHEPARD ELECTRIC CRANE & HOIST CO.

MONTOUR FALLS, N. Y.

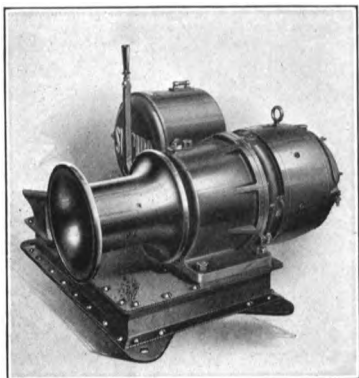
**DIRECT AND ALTERNATING CURRENT CRANES AND HOISTS FOR
EVERY SERVICE**

Gearing cut
from steel blanks.
Brakes are of the
multiple disc type
with automatic
compensation for
wear.

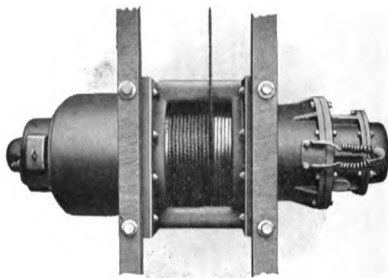


Form 6.—Standard Type Crane Trolley

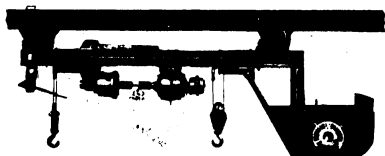
Gearing and
brakes located
within rigid cylin-
drical frame pro-
viding bath lubri-
cation and perma-
nent alignment.



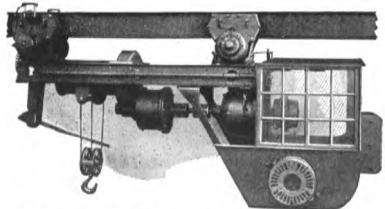
Back Geared Motor Winch



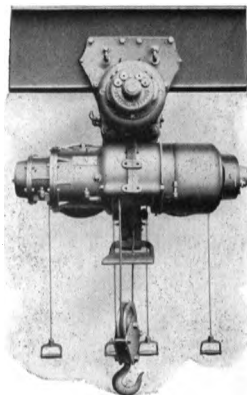
Form 8 Hoist, Crane and Derrick Type



Form 12.—Double Hook Monorail Type



Form 21.—Single Hook Monorail Type



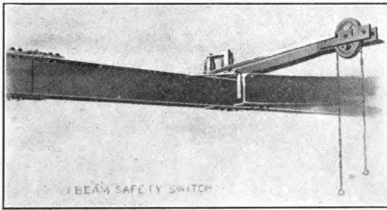
Form 1 Hoist with Motor Driven Trolley

PHILADELPHIA TRAMRAIL CO.

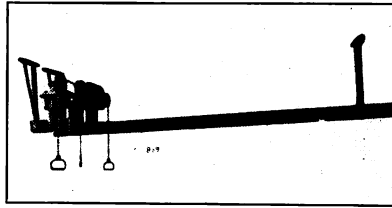
FRONT AND TUSCULUM STS., PHILADELPHIA, PA.

OVERHEAD TRACK SYSTEMS, SWITCHES AND TROLLEYS

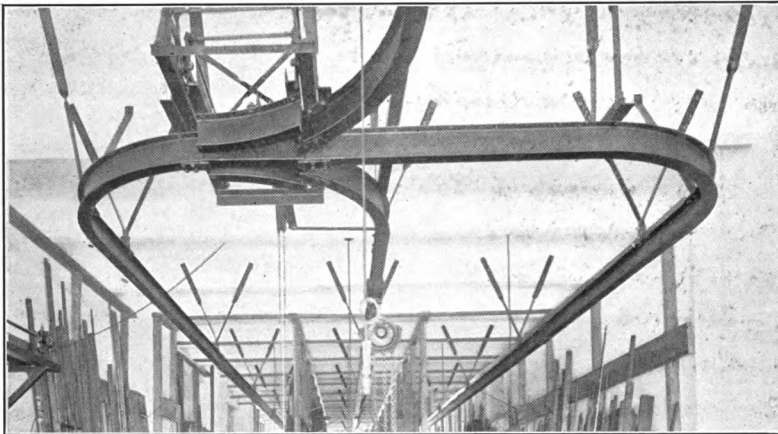
OVERHEAD TROLLEY EQUIPMENT



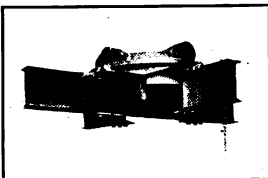
I-Beam Safety Switch



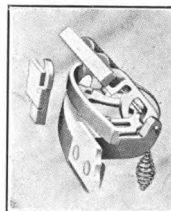
Heavy Flat Rail Safety Switch



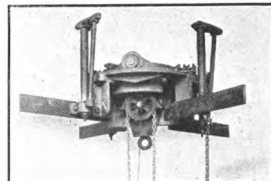
Tramrail System Showing Limit Switch



I-Beam Turntable



**Ideal Switch with
Safety Stop**



Flat Rail Turntable

Specialists on designing and installing overhead trolley systems for conveying all kinds of materials. Catalogue on application.

CLYDE IRON WORKS

29th AVENUE WEST, AND MICHIGAN ST., DULUTH, MINN.

**HOISTING ENGINES, DERRICKS AND DERRICK FITTINGS, ELECTRIC
HOISTS, BELT DRIVEN HOISTS, AUTOMATIC BUCKETS**

HOISTING ENGINES AND BOILERS OF CLYDE-GRADE

Our product is used for all kinds of Contractor's work, Dredging, Pile Driving, Railroad and Bridge Building, Quarries and general hoisting purposes. We also make a specialty of engines for skidding and loading logs, and for general logging operations.

All our engines are thoroughly tested under steam as well as by the usual hydrostatic test. All parts are made from standard jigs and templates and are absolutely interchangeable.

ONE, TWO, THREE, AND FOUR DRUM HOISTING ENGINES

In our 235 page catalog we illustrate the 2099 types and sizes of our standard engines with single or multiple drums, and single or double cylinders. These hoisting engines are regularly built with or without boiler, winch and sheave heads, and reversing gear. Clyde hoists of 7x10 and larger are built with all-steel gears.

DERRICKS AND DERRICK FITTINGS

In this large catalog we also illustrate and list a complete line of timber derricks and fittings. All usual conditions can be met with some one of our standard styles, but we are prepared to build derricks for any special conditions that may arise. For this purpose we maintain a force of draftsmen and engineers who are specialists in this line, and their experience of many years is at the disposal of our customers.

Clyde Derricks are designed with great care to withstand violent strains. Every possible point of weakness, both in the fittings and in their action on the timbers, has been guarded against and we claim our fittings to be the strongest on the market for the size of timbers for which they are intended.

Following is a partial list of our standard styles of derricks:

Standard Guy Derricks
Half Hand Power Guy Derricks
Hand Power Guy Derricks
Clam Shell Guy Derricks
Standard Stiff Leg Derricks
Half Hand Power Stiff Leg Derricks

Hand Power Stiff Leg Derricks
Clam Shell Stiff Leg Derricks
Full Circle Stiff Leg Derricks
Self-Propelling Derrick Cars
Self-Contained Portable Derricks
Bulletin "N" contains our new
line of All Steel Derricks

We also manufacture a complete line of logging machinery, of land-clearing machinery and of excavating machinery, including the FIELD TOWER EXCAVATOR for levee-building and drainage-canal digging.



S. FLORY MFG. CO.

BANGOR, PENNA.

HOISTING ENGINES OF EVERY DESCRIPTION, CABLEWAYS, DREDGING MACHINERY, SLATE AND STONE WORKING MACHINERY, DERRICK FITTINGS

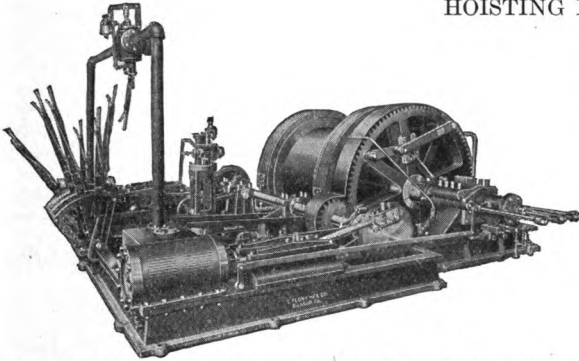


Illustration shows a Flory Mine Hoist 20x24 Cylinders, Piston, Valves.
Werner Patent Band Friction Operated by Steam, Two Asbestos
Brakes Operated by Steam, Balance Throttle

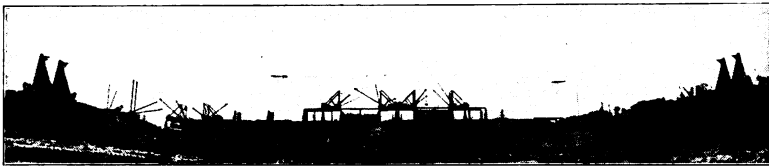
MINING on Planes or Slopes with varying grades, where the low speed is used on the heavier grades.

HOISTING ENGINES for Mines, Quarries, Contractors, Logging and Specials for Derricks, Bridge Building-Boom Swingers.

BELT HOISTS for shop and mill purposes.

DREDGING MACHINERY: Engines and accessories for all types of Dredges.

DRAG LINE engines with the most powerful frictions, two speed, adapted for Levee building, sand pits, etc., or in



Flory Cableways on the Kensico Dam, Valhalla, N. Y.

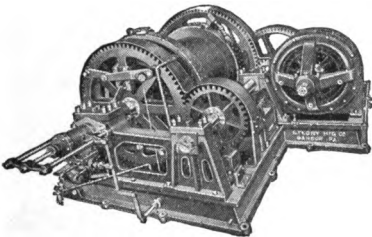
CABLEWAYS for Bridge and Dam Building, Removing Top conveying materials, Sewer Building, etc. The most simple and inexpensive form.

SLATE and STONE WORKING machinery—Saws, Planers, Groovers, Rubbing Beds, Dressing machines, etc.

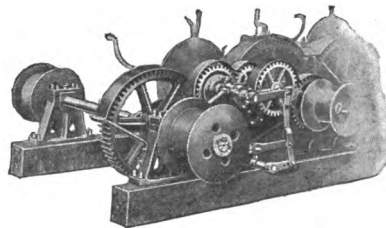
We are in a position to furnish any parts of Steel.

HOISTS ELECTRICALLY OPERATED can be furnished up to 600 H.P.

FLORY HOISTS are designed right. They are built right. We guarantee them. Our Catalog shows hoists adapted for all kinds of work. It is yours for the asking.



Two Speed Electric Mine or Drag Line Hoist
with Two Patented Band Frictions



Derrick Hoist with Patented Boom Swinging
Attachment

LIDGERWOOD MANUFACTURING CO.

MAIN OFFICES

96 LIBERTY ST., NEW YORK

BRANCH OFFICES:

**CHICAGO, Fisher Building
SEATTLE, 807 Western Ave.**

**PITTSBURGH, Union Bank Building
PHILADELPHIA, Commercial Trust Building
CAXTON HOUSE, WESTMINSTER, LONDON, S. W. ENGLAND,**

HOISTING ENGINES, ELECTRIC HOISTS, CABLEWAYS, DREDGING AND EXCAVATING MACHINERY, LOGGING MACHINERY

FOREWORD: The Lidgerwood hoisting machinery of today embodies every improvement in design and construction developed by our 42 years experience. We have devoted ourselves exclusively to the manufacture of hoisting and hauling machinery.

It is our practice to design the complete machine to operate under the maximum service it is to perform, and to build every part of the machine to meet the full working capacity of the machine.

Every part is accurately constructed upon the duplicate part system, insuring the absolute fitting of repair parts.

We have kept pace with the development of electrical engineering, and can supply our electric hoists equipped with the latest automatic control and safety devices, and type of motor best adapted for the work to be done by the hoist.

Our friction drum hoists have cork inserted friction woods. This increases the holding power of the friction and greatly reduces the power required to apply the friction. The entire friction mechanism is extremely simple.

STEAM, ELECTRIC AND GASOLINE HOISTS for all kinds of derrick service, including grab bucket work.

STEEL DERRICKS of all types; derrick fittings for wooden derricks.

PILE DRIVING HOISTS, pile driving frames and hammers.

HIGH SPEED BUILDERS HOISTS for operating material and hod elevators.

STEAM AND ELECTRIC HOISTS designed for shaft and tunnel work, bridge erection and to meet every requirement of contracting work.

DREDGING AND EXCAVATING MACHINERY. Steam and electric bucket and swinging engines for operating grab buckets on land and water outfits, both for dredging, and for loading and unloading sand, gravel and coal barges.

Spud engines and cutter engines for suction dredges.

Built with special regard to the severe duty such machines perform.

DRAG LINE EXCAVATORS of the revolving type, characterized by the digging quality of the bucket, the powerful engine operating same, and the strength of the entire machine consistent with its digging power.

Drag line excavators of the cableway type, with traveling towers and spans to meet the service required.

CABLEWAYS: Lidgerwood cableways, steam or electrically driven to handle loads of from one to fifty tons, with spans up to 3,000 feet and with fixed or traveling towers. They are equipped to handle plain skips, automatic dumping skips, concrete tubs, clamshell, orange peel, or scraper excavator buckets. A prominent feature is the high speed fall rope carrier.

MINE HOISTS for every character of incline haulage and mine shaft service. Steam hoists built up to 1000 H.P. and electric in any size, and fitted with complete control and safety appliances.

LOG HANDLING SYSTEMS: High speed ground and overhead log skidding systems.

RAPID UNLOADERS for unloading ballast cars.

CAR HAUL HOISTS.

INCLINE COAL HOISTS.

COAL TOWER BUCKET AND TROLLEY HOISTS.

SHIP'S CARGO WINCHES.

STEERING ENGINES.

We will gladly send catalogues covering above products.

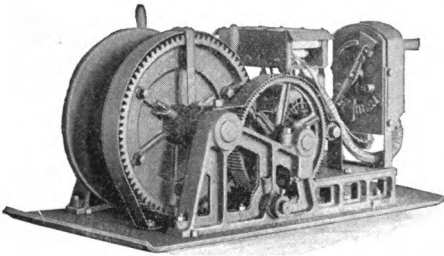


THE PNEUMEELECTRIC MACHINE CO.

SYRACUSE, N. Y.

ELECTRIC HOISTS, PUMPS, COAL CUTTERS, ROCK DRILLS

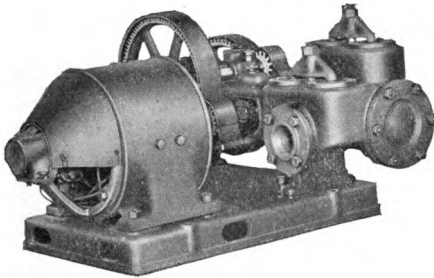
Pneumelectric
TRADE MARK



Electric Hoist

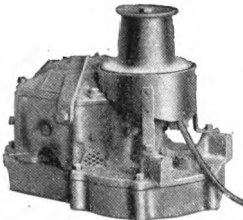
THE PNEUMEELECTRIC HOIST is electrically operated. It is used in mines, industrial plants, quarries, by contractors and wherever it is necessary to move cars, wagons, trucks or any other kind of a load under conditions which make the work too hard for men or animals and too light for the economical use of a larger machine or small locomotive.

It is very rugged and compact. The electrical equipment is built to withstand the very severe service demanded of machines of this type and is of sufficient capacity to properly handle loads requiring as much as five horse power.



Electric Pump

ELECTRICALLY OPERATED PUMPS of small capacities are in general use and have become firmly established as most economical, reliable and useful. The Pneumelectric Pump has a capacity of 60 gallons per minute against a head of 150 feet. It can be easily moved from place to place as it is designed for use where water is temporarily found, as well as under conditions where a Pump must be used constantly. Simplicity, ease of access to all parts and ruggedness are highly developed features of this Pump.



Electric Cap-Stan

THE PNEUMEELECTRIC CAP-STAN is provided so that a hemp rope may be used and is particularly desirable for many classes of work because of its flexibility, light weight and compact construction.

The Cap-Stan or rope drum is designed to produce a maximum pull on the rope representing a safe load for the motor, which is of five horse power capacity.

This machine is universally applicable and can be used to advantage in handling loads under any conditions.

Full information and quotations will be furnished upon application.

EASTON CAR & CONSTRUCTION CO.

(Successors to Ernst Wiener Company)

MAIN OFFICE AND WORKS, EASTON, PA.

NEW YORK BOSTON ATLANTA PHILADELPHIA PITTSBURG
DETROIT CHICAGO MILWAUKEE ST. PAUL

DESIGNERS AND BUILDERS OF INDUSTRIAL CARS AND TRACK.
PLATE, TANK AND STRUCTURAL STEEL WORK



Fig. 251. Complete Track Layouts; Any Gauge and Weight of Rail



Fig. 94. Standard Cast Iron Ball-Bearing Turntable

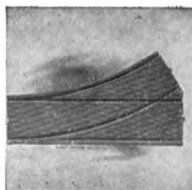


Fig. 185. Cast Iron Plate Switches and Cast Iron Plate Track

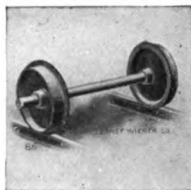


Fig. 86. Wheels and Axles of Any Design, Accessories of all Kinds

INDUSTRIAL RAILWAYS

We supply everything for Industrial Railways. In fact, the planning, building, equipping and supplying of railways for industrial purposes is our specialty. We have complete facilities for handling all requirements quickly, thoroughly, and at reasonable prices.

Complete track layouts are made in our own shop, including straight track, curves, switches, crossings and turn-tables. When shipped everything is ready to lay. It is only necessary for your men to fishplate the sections together. Then your railway is ready for immediate use.

We build all styles of industrial cars, made of either wood or steel, or steel and wood combined. If our standard types are not suitable we construct special types from customers' specifications or assist them in perfecting and executing their ideas.

Put your conveying problems up to us. We will plan an industrial railway to meet *your* needs and to perform *your* work in the most economical manner.



TRADE MARK



Fig. 286. Platform Cars with Wooden or Steel Flooring, Steel Frame

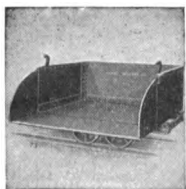


Fig. 73. Charging or Boiler Room Cars



Fig. 249. All-Steel, Gable Bottom Cars, 4 or 8 Wheels

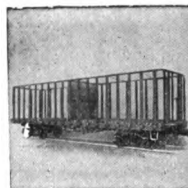


Fig. 180. Double Truck Cane Cars—Built up to 30 Tons Capacity and having Any Style of Super-structure

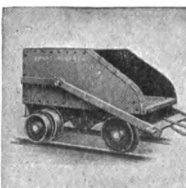


Fig. 268. All Types of Skips for Every Purpose and Every Condition



Fig. 255. Rocker Dump Cars, Built for Any Capacity and Gauge; with or without Brakes

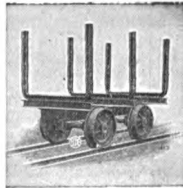


Fig. 419. Cars of all Kinds for Rolling Mills and Steel Plants. Cars for Charging Boxes, Ingots, Bar Iron, Pipe, Etc.

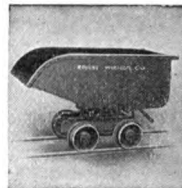


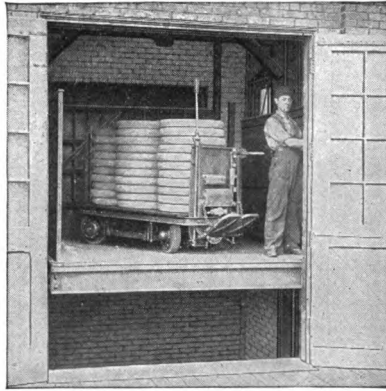
Fig. 270. Rotary Scoop Shaped Dump Car

THE ELWELL-PARKER ELECTRIC CO.

MAIN OFFICE AND WORKS: CLEVELAND, O.

NEW YORK OFFICE: 50 Church Street

**THE ORIGINAL FOUR WHEEL STEER ELECTRIC STORAGE BATTERY
RAILWAY AND INDUSTRIAL TRUCKS, TRACTORS AND TRAILERS**



Trucks for every purpose—to lift, load and unload raw or finished materials of any shape or size and carry or trail loads between buildings, floors and departments.

For use in Steel, Paper, Cotton and Textile Mills; Lumber, Clay Working, Salt, Sugar, Chemical and Automobile Plants; Passenger Stations, Freight Terminals, Warehouses and Piers; Factories, Machine and Railroad Shops.

Types—Plain, elevating, spring platform, drop and straight frame, hopper, tank, side or end dump and crane, also combinations of the above for floor, yard or rail.

Specifications—Carrying capacities, 4000 lbs.

Speeds, $4\frac{1}{2}$ to 8 m.p.h.

Platform lengths, 4 ft. to 13 ft.

Trailing capacities, 10 to 100 tons.

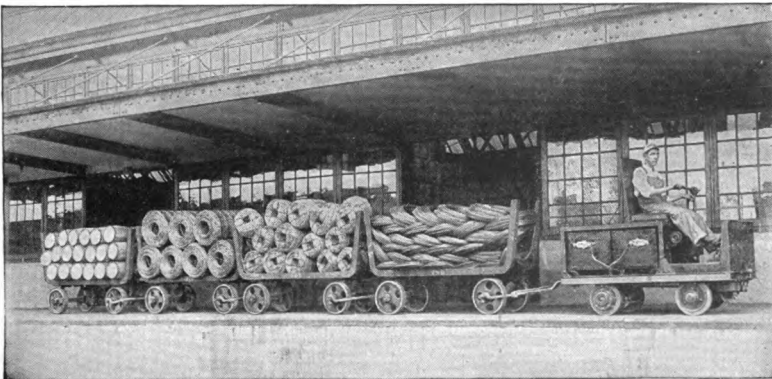
Platform heights, 11 in. to 33 in.

Widths, 26 in. to 60 in.

One of these trucks will do the work of from three to fourteen men in one half the time required for hand trucking, on account of capacity and speed. The same floor space is used oftener and aisles are not congested as when using old style hand trucks.

Trucks turn in narrow aisles or on platforms crowded with merchandise. Four wheel steer and short turning radius makes this possible.

Unskilled labor can be taught to operate in few hours. Control and braking automatic—"fool proof." Costs about 30 cents per charge with one cent 110 volt current.



C. W. HUNT COMPANY, INC.

WEST NEW BRIGHTON, STATEN ISLAND, NEW YORK

New York City Office: 45 Broadway

COAL AND ASH HANDLING MACHINERY, PIVOTED BUCKET CONVEYORS, HOISTING AND CONVEYING MACHINERY, CABLE AND AUTOMATIC RAILWAYS, STEEPLE TOWERS, SKIP HOISTS, INDUSTRIAL RAILWAY EQUIPMENTS, ELECTRIC LOCOMOTIVES, MOTOR CARS, STORAGE BATTERY INDUSTRIAL TRUCKS, TRANSMISSION AND HOISTING ROPE, SPECIAL SCALES AND WEIGHING HOPPERS, COAL CRACKERS



Single Door Charging Car



Storage Battery Industrial Truck

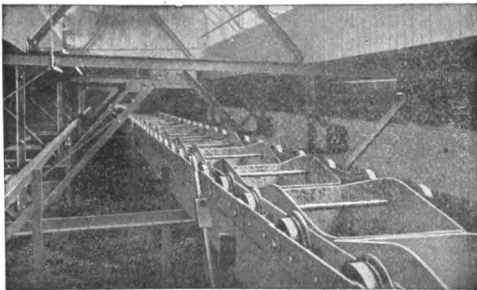
176

INDUSTRIAL RAILWAYS AND CARS AND STORAGE BATTERY INDUSTRIAL TRUCK

The boiler room cars for bringing coal to boilers are so designed that the labor of firing is reduced to a minimum, and the boiler room is kept clean. We design all types of cars for use in foundries, machine shops and all kinds of manufacturing plants. The use of outside flanged wheels permits one man to push a one ton load on a sharp curve. Ask for catalog U-12-1 on "Industrial Railways."

The Storage Battery Industrial Truck is designed to take the place of hand trucks, has a capacity from 2000 to 4000 lbs.; is simple and reliable. Catalog U-13-4 on request.

PIVOTED BUCKET CONVEYORS consist of a series of independent swinging buckets free to dump in either direction. Conveyors can run in any direction, the buckets hanging in an upright position, therefore dry or liquid material can be handled. The peculiar system of driving by a pawl relieves the conveyor wheels of all stress.



Hunt Conveyor over Coal Bunker

Ask for catalog U-12-9 on Conveyors.



C. W. HUNT COMPANY, INC.
WEST NEW BRIGHTON, NEW YORK

HUNT STEEPLE TOWERS

are designed to be operated by one engineer. One engine is required for hoisting the steam shovel and another for running the trolley on the booms. Great speed makes these outfits especially suited to rapid unloading of vessels. The projecting booms are usually hinged to swing horizontally over the wharf. Where obstructions such as the rigging of vessels interfere, the booms can fold up in a vertical plane. Capacity of buckets ranges from $\frac{1}{2}$ to $2\frac{1}{2}$ tons.

HUNT TRANSPORTING BRIDGES are adapted to the storage and reclaiming of coal over large areas. The one shown has a four-drum equalizing engine and operates with grab buckets at a capacity of 120 tons per hour. Furnished in capacities up to 600 tons per hour.

INCLINED BOOM HOISTING ELEVATORS

are for rapid and economical hoisting of materials from vessels. The bucket, whether large or small, is carried from the hold of the vessel to the dumping place every trip in exactly the same course, and at any rapidity demanded. The bucket is carried exactly where wanted, rising vertically from the hold to the boom, running up the boom, and dumping at a fixed place.

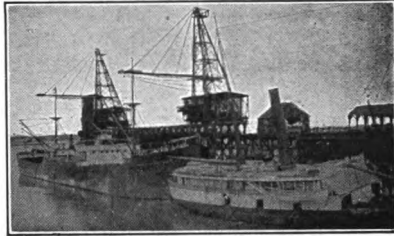
These elevators are proportioned to suit the work and for use either with tubs or grab buckets. The lighter size is especially adapted for coal or ore hoisting, using any size bucket up to one-ton capacity.

HUNT MOTOR CARS

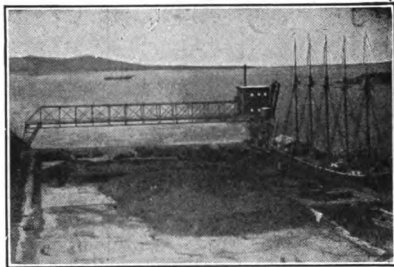
Self-Dumping

made in many types, capacities up to 10 tons, and are equipped with motors and overhead trolleys or shoes for third rail as desired. Suitable for transporting coal, fertilizer materials, ores, and other bulk materials.

General catalog U-102 on request.



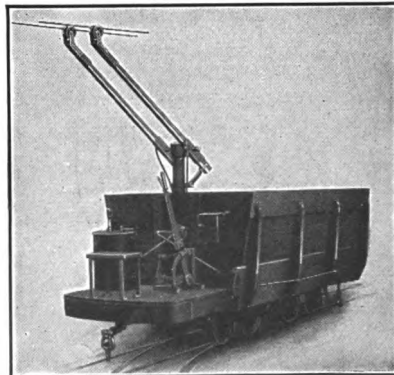
Hunt Steeple Towers



Hunt Transporting Bridges



Inclined Boom Hoisting Elevators



**Hunt Motor Cars
Self-Dumping**

G. L. STUEBNER IRON WORKS

HANCOCK ST. AND VERNON AVE.

LONG ISLAND CITY, NEW YORK, N. Y.

**MANUFACTURERS OF HOISTING BUCKETS, NARROW GAUGE CARS,
WHEELBARROWS, FURNACES, ETC.**



Turn-over and Bottom Dumping
Buckets of all Types and Sizes; Steel
Skins.



Flat, End and Bottom Discharge
Industrial Cars and Track.



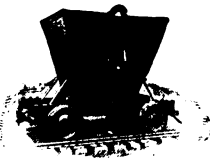
Push Carts for handling Coal, Ores,
Earth, Concrete, Etc.



Asphalt Heaters and Lead Melting
Furnaces, Etc.



Catalogue No. 550



**CATALOGUE SECTION
PART III**

**Metal Working Machinery
Machine Tools and Accessories
Shop Equipment**

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Pages 181—226

E. W. BLISS COMPANY

19 ADAMS STREET, BROOKLYN, N. Y.

BUILDERS OF SHEET METAL WORKING MACHINERY

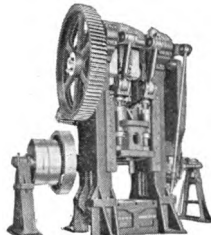
**PRESSES, DIES, SHEARS,
DROP HAMMERS,
DOUBLE SEAMERS,
SPECIAL MACHINERY**



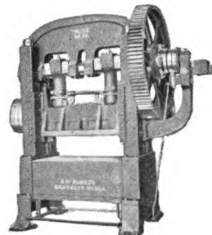
**"Bliss" Inclined
Power Press**



**"Stiles" Punching
Press**



**"Bliss" Toggle Drawing
Press**



**"Bliss" Double-Crank
Press**

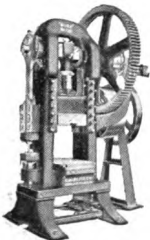
The most complete line of machines for sheet metal working in the world.

Presses for every ordinary kind of work and special machines for unusual requirements. Hinge and Butt machinery, Fork and Spoon machinery, Expanded Metal Lath machinery, Shovel machinery, Horse Shoe machinery, Minting machinery, Automobile Parts machinery, Spinning Lathes, Gang Slitters, Circle Shears, Perforating, Punching, Slitting, Shearing, Beading, Flanging, Crimping and Seaming machines.

Complete equipments for the economical manufacture of Petroleum and Alcohol Cans, Fruit and Vegetable Cans, (Sanitary and Packers'), Meat Cans, Paint and Varnish Cans, Lard Pails and Butter Tins, and all kinds of Tin Canners, Boxes and Packages.

Machinery for manufacturing Soft Metal Tubes, Aluminum, and Silverware, Metal Shingles, Metal Ceilings, Sheet Metal Furniture, Kitchen Utensils, Kitchen Boilers, Oil Stoves, Lamps, etc., etc.

We are also equipped for die work of every description.



**"Bliss" Trimming
Press**

**Tin and Enamel Ware Machinery
Metal Package Machinery
Automatic Tin Can Machinery
Electrical Parts Machinery
Automobile Parts Machinery
Drop Forging Machinery**



**"Stiles" Drop
Hammer**

THE LONG & ALLSTATTER CO.

HAMILTON, OHIO, U. S. A.

MANUFACTURERS OF POWER PUNCHES AND SHEARS

POWER PUNCHING & SHEARING MACHINERY
COPING MACHINES—STRUCTURAL PUNCHES
RIVETING MACHINES—TIRE WELDING MACHINES
ARMATURE DISC NOTCHING MACHINES
HELVE HAMMERS

One of the pioneers in their line whose tools may be found in most of the larger and more important metal-working establishments in our own country and many in Europe.

To those familiar with the trade, the name of this firm is a synonym for quality, workmanship, efficiency and durability.

PUNCHING MACHINES **SHEARING MACHINES**

A complete line of open-throated type, large and small, single and double-ended, belt, steam or electrically driven (customer's option); a carefully graduated schedule for general purpose use, with modifications in endless variety for special work of all kinds.

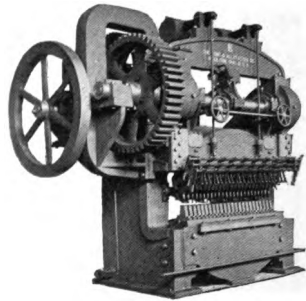
MULTIPLE PUNCHES **GATE SHEARS**

Varying in width between housings and depth of throat to suit customers' requirements; to punch any number of holes, in groups or in rows, with fixed or adjustable centres, or cut off and trim plates or sheets of any width or thickness.

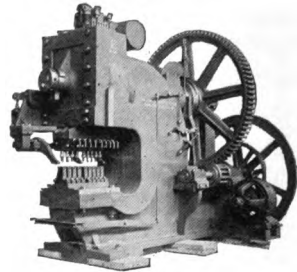
COPING MACHINES **STRUCTURAL PUNCHES**

A full line, for coping and punching large and small structural sections (beams, channels, angles, etc.), of all kinds and sizes with the widest range of equipment.

Write us regarding your problems in punching and shearing—correspondence solicited. Estimates furnished on request. If interested, you may have a catalogue for the asking.



Multiple Punch



Structural Iron Punch



Horizontal Punch and Bending Machine

WILLIAMS, WHITE & CO.

MOLINE, ILLINOIS, U. S. A.

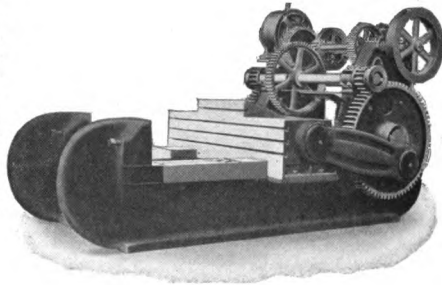
PITTSBURGH OFFICE
808 House Building

CHICAGO OFFICE
933 Monadnock Block

FORGING, PUNCHING AND SHEARING MACHINERY COALING STATIONS

BULLDOZERS: Nearly forty years of Bulldozer manufacturing. These machines are used for an incredible number of purposes. Most general purpose Press in existence. Built in ten sizes, and two types.

YEAKLY VACUUM HAMMERS: Recent and important improvements place this hammer at the head of Forging Hammers, both in power and control. Speed of blow is maintained, forging both light and heavy. Built in sizes from 40 to 650 lbs. Adaptable to motor drive.



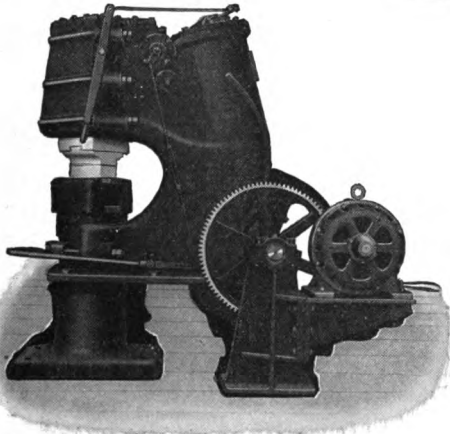
Bulldozer

JUSTICE SPRING HAMMER: Silico manganese steel springs furnished.

MOLINE HELVE HAMMER: Extra heavy in design.

BOARD DROP HAMMER: Very much improved. Exceptionally easy of operation and large output.

CRANK (OR ROPE LIFT) DROP HAMMERS: Stand very severe service with comparatively small upkeep. Particularly adapted to the carrying of large dies, for bending, shaping, forming and straightening. Made in three styles of Lifters,—Sandage, Ratchet and Peck.



Yeakley Hammer

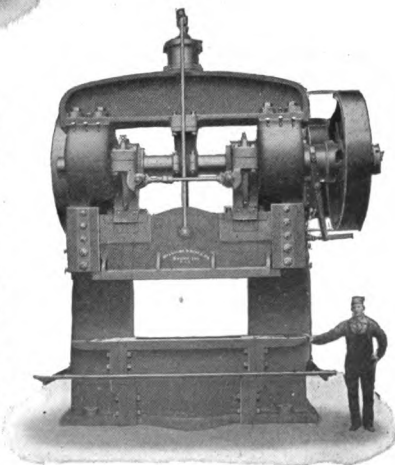
MULTIPLE PUNCHES: These machines are made in nine sizes with varying lengths and throats. Special adaptations for special work furnished. Machines range in weight from 5,000 to 250,000 lbs.

PUNCHING AND SHEARING MACHINES "C" type, Double and Single End Machines. Open fronted Bar Shears, and Guillotine Shears.

COPING AND STRUCTURAL PUNCHES AND SHEARS: Complete line of the above machines, covering a wide range of throats, capacities, types of jaw, equipment, etc.

Our line also includes, Upsetting, Forging and Rivet Machines, Eye Benders, Multiple Head Tapping Machines, Bending and Straightening Machines, Horizontal Punches, Hydraulic Presses Stay Bolt Breakers, Rotary Riveting Hammers, Angle Bending Rolls and Angle Shears.

COALING STATIONS FOR COALING LOCOMOTIVES.



Multiple Punch

ATLAS PRESS CO.

310 No. PARK ST., KALAMAZOO, MICH., U. S. A.

EFFICIENT ARBOR PRESS EQUIPMENT

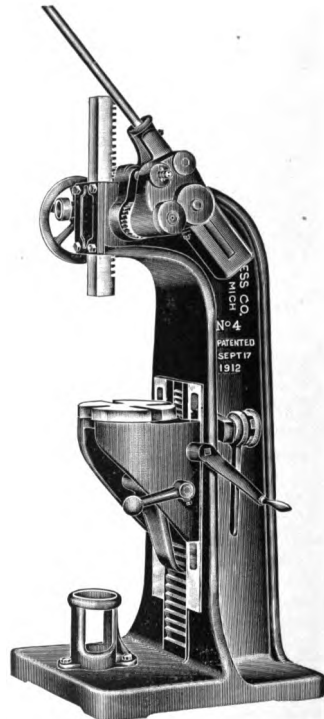
ATLAS PRESSES are built in all sizes to meet every requirement for tools of this type. Pinions are cut from forgings of Chrome Vanadium—Rams from specially treated Chrome Nickel. All parts designed to give highest degree of efficiency under all service conditions. Complete details upon request. Carried in stock by leading machinery dealers everywhere.



No. 24 Press



No. 3 on Stand



No. 4 Press

SEAMAN, SLEETH COMPANY

PHOENIX ROLL WORKS

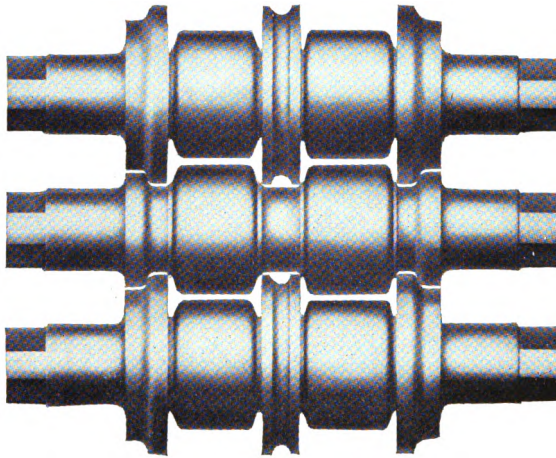
PITTSBURGH, PA.

**MANUFACTURERS EXCLUSIVELY OF PATENT SEMI-STEEL CHILL
AND SAND ROLLS AND PINIONS; STEEL ROLLS AND PINIONS**

ROLLS AND PINIONS FOR ROLLING MILL MACHINERY

We have prepared a catalogue for users of rolls for all purposes, to show our facilities for getting out work, and therefore with our practical experience of fifty-five years in casting, finishing and designing rolls, as is generally known, we are able to design and finish rolls for any purpose to the entire satisfaction of the trade.

Our foundries, two in number, are under one management and are equipped for casting rolls of all sizes and for all purposes. All small rolls are made in No. 1 Foundry up to and including sheet tin plate and semi-steel rolls for all purposes. Semi-steel being our improvement and patented in 1871 has been in constant use and since the patent expired has come into general use. No. 2 Foundry is intended for our heavier roll castings, such as are used for rails, structural work, chilled plate rolls, etc.



Three-high I-Beam Intermediate Rolls—Steel, Semi-steel, or Sand

We guarantee the working of all rolls we design, whether it is one pair or one set or the entire equipment of a mill. We do not build mills, however, as we have found that the manufacture and finishing of rolls should be a special branch of trade, conducted by special men trained in that particular line. This induced us in 1870 to make a specialty of rolls; being the first in the world to do so. Previous to this we had a general foundry. We have the necessary trained men and superintendents, and with our plant as shown and described in our catalogue, together with a list of mills given which we have supplied with rolls when they were built, and to whom we refer all parties intending to build as to results obtained on said mills, you can readily see our advantage.

Besides the mills listed in our catalogue, there are a large number of others whom we have supplied, and the bulk of our trade to-day is in supplying rolls, rough or finished, to the general trade. By furnishing us a sketch of what is wanted, we will be pleased to design rolls to roll it, and further, parties coming to our office can see thousands of drawings of special or regular sections. We invite you to come to see us.

THE ACME MACHINE TOOL CO.

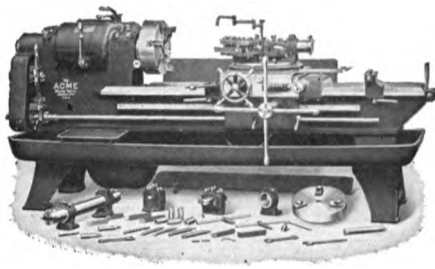
CINCINNATI, OHIO, U. S. A.

Code Word: ACME

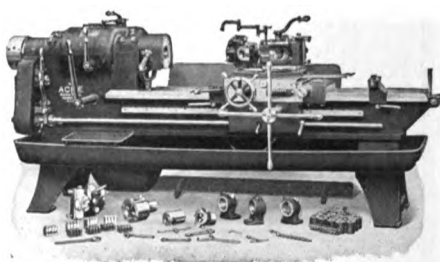
Lieber's Code

CINCINNATI ACME

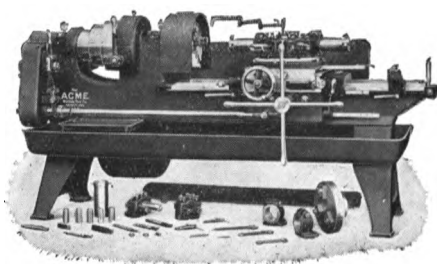
Flat Turret Lathes, Screw Machines, Turret Lathes, Brass Working Machines, Universal Turret Lathes, and all Tool Accessories



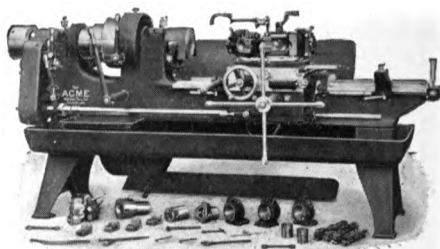
3 1/4"x36" Flat Turret Lathe with Chucking Equipment



3 1/4"x36" Flat Turret Lathe with Bar Equipment

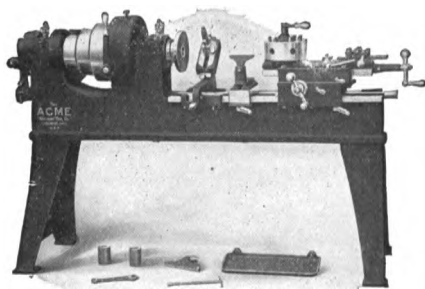


2 1/4"x26" Flat Turret Lathe with Chucking Equipment

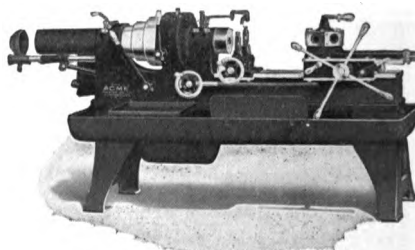


2 1/4"x26" Flat Turret Lathe with Bar Equipment

Flat Turret Lathes, the double purpose machines. Adapted to both bar and chucking work. Using simple inexpensive tools. The greatest producers of work from bar stock, forgings and castings. Capacity bar stock 2 1/4" and 3 1/4" and chucking work 12" and 16" diameter.



18" Universal Turret Lathe



2 1/4"x11" Screw Machine

Screw Machines made in five sizes. Automatic Chuck capacity 1/2" to 2 1/4", 11" to 20" swing. Plain or friction geared head with or without automatic feed to turret.

Turret Lathes and Brass Working Machines made in four sizes. 14" to 20" swing. Plain or friction geared head, with or without automatic chuck, bar feed, automatic feed to turret, or cut off rest. Furnished with plain, set over or universal turret, also chasing attachment, forming attachment and all tools for rapid and accurate production.

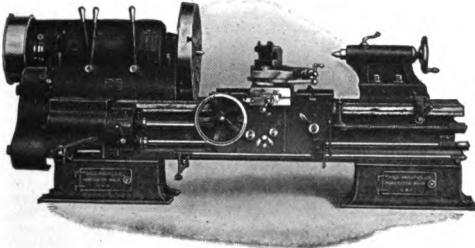
REED-PRENTICE COMPANY WORCESTER, MASS.

F. E. REED CO. DEPARTMENT
Established 1875

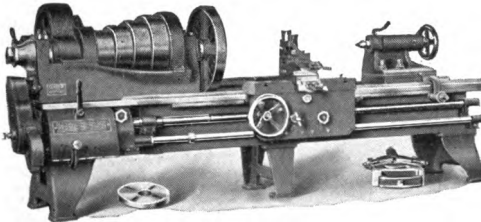
PRENTICE BROS. CO. DEPARTMENT
Established 1872

BUILDERS OF LATHES AND DRILLING MACHINES

LATHES



"Reed-Prentice" 27" High Speed Geared Head Lathe



"Reed-Prentice" 24" Heavy Duty Lathe

Geared Head High Speed Lathes: The "Reed-Prentice" High Speed Geared Head Lathe has an **all-friction clutch head stock** making it the most rapid speed changing lathe built. Made in 12", 14", 16", 18", 20", 27" sizes. The "Reed-Prentice" High Speed Turret Lathe is a powerful and rigid machine designed for the rapid production of duplicate parts. Built in 16" and 18" sizes.

Heavy Duty Double Back Geared: The "Reed-Prentice" Heavy Duty Lathe is designed and built to withstand the strain of constant heavy turning, and is especially adapted for Railroad and all kinds of Heavy Duty. Made in 16", 18", 20", 22" and 24" sizes.

Plain Turning—Double Back Geared: The "Reed-Prentice" Three Step Cone, Double Back

Geared Lathe is a rigid and powerful type of machine, designed to meet the demand for a modern engine lathe having sufficient power to use high speed steel cutting tools economically. Made in 14", 16", 18", 20", 27" sizes.

Standard Single Back Geared: The "Reed-Prentice" Engine Lathe is an accurate, reliable machine, embodying high-grade workmanship throughout. Made in 9", 12", 14", 16", 18" sizes. The 9" size is a screw cutting lathe of exceptional value for small work.

The "Reed-Prentice" Standard Engine Lathe is especially adapted for a wide range of work, both light and heavy. Made in 10", 12", 14", 16", 18", 20", 22", 24" sizes. The 10" lathe is well adapted for experimental and also light work.

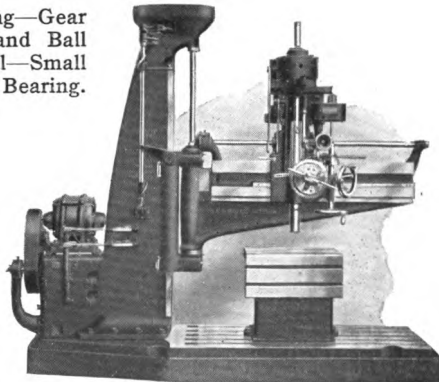
DRILLS

Radial, Plain and Ball Bearing—Gear Speed Change Vertical, Plain, and Ball Bearing Standard Pattern Vertical—Small Upright Sensitive Plain and Ball Bearing.

Ball Bearing Sensitive Drilling Machines: Built with one, two, three, four, five and six spindles. Amply "rigid" in construction to stand high spindle speeds without vibration.

Upright Drilling Machines: Built in 20", 21", 23", 24", 26", 28", 30", 36" sizes.

Ball Bearing Radial Drilling Machines: Centralized control of all levers reduces lost time to a minimum. Standard pattern made in 3', 4', 5', 6' Arm size. Heavy pattern made in 3', 4', 5' Arm size.



"Reed-Prentice" 4' Arm Heavy Pattern Radial Drilling Machine

JONES & LAMSON MACHINE CO.

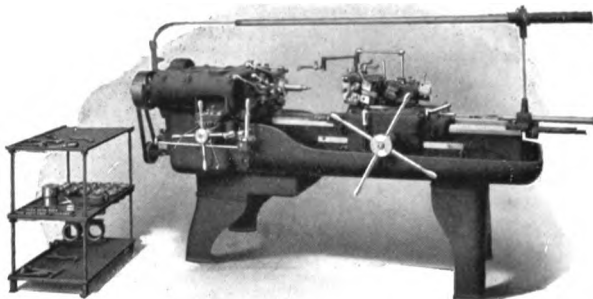
SPRINGFIELD, VERMONT, U. S. A.

97 QUEEN VICTORIA STREET, LONDON.

Germany, Holland, Switzerland, Austria-Hungary: M. Koyemann, Charlottenstrasse 112 Düsseldorf. France, Spain and Belgium. F. Auberty & Co., 91 Rue de Maubeuge, Paris.

HARTNESS FLAT TURRET LATHE, FAY AUTOMATIC LATHE

TURRET LATHES



2 1/4 x 24 HARTNESS FLAT TURRET LATHE WITH BAR OUTFIT

Geared, quick change speeds and feeds, flat turret, stops that really stop, and the famous set of bar tools, capable of almost any stunt within the dimensional capacity of the machine. Equipped with the Hartness Automatic Opening Die.

WORKING RANGE. Hole through spindle is 2 1/2 inches in diameter. Greatest length turned is 24 inches. Swing over

carriage is 12 1/2 inches. Cross travel of head is 8 1/2 inches. Equipped to handle round rough bars up to 2 1/4 inches in diameter; hexagon and octagon bars up to 1 1/2 inches; square bars up to 1 1/4 inches, and flat bars up to 1 1/2 x 1 1/2 inches. With special jaws, flat stock up to capacity of spindle.

The 3x36 machine with bar outfit is the same thing on a larger scale; capacity as follows:

WORKING RANGE. Hole through spindle is 3 1/2 inches in diameter. Greatest length turned is 36 inches. Swing over carriage is 14 1/2 inches. Cross travel of head is 8 1/2 inches. Equipped to handle round rough bars from 1 to 3 inches in diameter; hexagon, octagon, square and flat bars from 1 to 2 inches. With special jaws, hexagon and octagon up to 2 1/2 inches and flat stock up to capacity of spindle.

Both machines also sold with outfit for chucking work, as shown on 3 inch machine below.

3x36 HARTNESS FLAT TURRET LATHE WITH CHUCKING OUTFIT

THE CROSS-SLIDING HEAD. This is the only turret lathe in which the work-carrying headstock has a cross travel. This is indispensable on chuck work and is frequently convenient on bar work. It gives a cross feed for every tool without resorting to the frail double slide under the turret. Nine speeds in both directions from 13 to 284 revolutions per minute instantly obtainable. All gears run in oil bath.

THE TURRET. This is the original flat turret, 18 inches in diameter, and is gibbed at outer edge. Index pin is located directly under working tool.

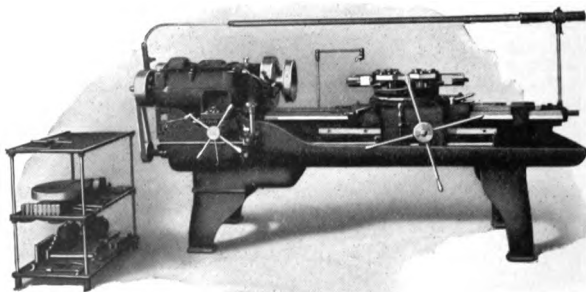
THE POWER FEED. Both the carriage and the cross-sliding headstock are provided with power-feed. It operates in both directions; has nine changes, from 20 to 120 revolutions per inch of travel. These changes are instantly obtainable by sliding gears.

STOPS. Each position of turret is equipped with two separate stops, making twelve in all. If desired, seven stops can be used for one tool. The cross travel of the head is controlled by nine stops. Both sets of stops act in both directions, and are placed as near as possible to the direct line of stress.

The swing over the carriage is 14 1/2 inches. Cross travel of head, 8 1/2 inches. Hole through spindle, 3 1/2 inches.

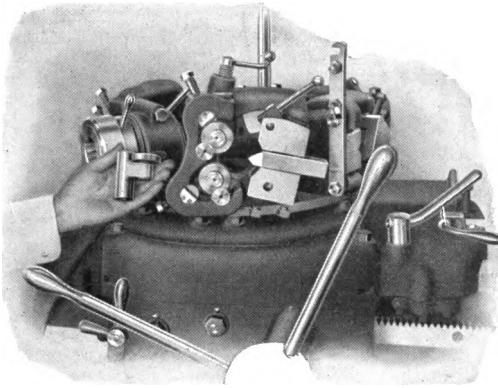
The 2 1/4 x 24-inch machine swings with chucking outfit 12 1/2 inches; same cross travel.

TOOL EQUIPMENT. Besides the scroll chuck and face plate for holding the work, the machine is equipped with an outfit of boring bars, drill holders and cutting tools, which make it ready to handle ordinary work as soon as supplied with driving power.



JONES & LAMSON MACHINE CO.

SPECIAL FEATURES



THE ORIGINAL FLAT TURRET

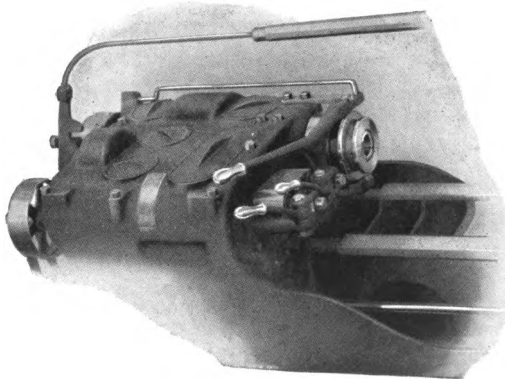
The Flat Turret, shown herewith, was put on the market in 1891. Over nine thousand (9,000) machines equipped with them have been built and sold since, to the great satisfaction of the users. A large, steady tool clamping surface, a circular gib holding the turret down clear around its periphery, a locking pin directly under the cutting point of the tool—all these

features combined to set a new standard of output, accuracy and range of work in turret lathe practice.

The unique set of tools shown covered at one leap the evolution from the old-fashioned "screw machine" to the modern turret lathe. It enabled the turret lathe to practically displace the engine lathe on bar and stud work.

THE CROSS-SLIDING HEAD

This feature, introduced in 1903, led another invasion into the engine lathe field, capturing most of the chuck work of moderate size. The Cross-Sliding Head has three advantages. (1) It offers a cross sliding motion gibbed directly and securely to the bed. There is no piling of slide on slide, no narrow bearing foundation for a lofty superstructure of slide, tool post and tool. (2) It permits the cross feed to be applied to every tool on the turret if necessary. (3) By allowing a cross adjustment to every tool, complicated and costly special tools are minimized. The regular outfit covers all regular work. The design is so stable that the pivoted type of holder is seldom needed.



(Continued on next pages.)



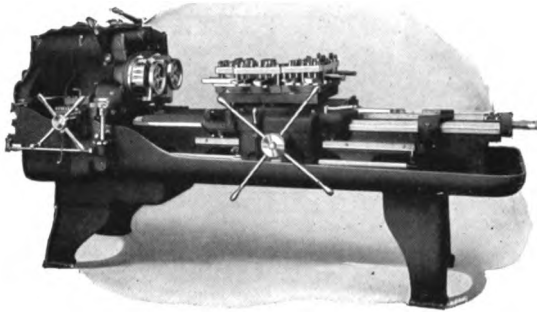
(Continued from preceding pages.)

JONES & LAMSON MACHINE CO.

SPRINGFIELD, VERMONT, U. S. A.

HIGH PRODUCTION MACHINES

HARTNESS DOUBLE SPINDLE FLAT TURRET LATHE FOR CHUCKING WORK



Two spindles, two sets of tools, two pieces of work. One turret, one cycle of operations, one operator. Practically double the output at about the same expense.

Introduced four years ago, and now the leading machine in the automobile field, and in similar lines where chuck work comes in large lots.

WORKING RANGE. Swing over carriage is 17 inches. Swing when both spindles are used is 10 inches. Cross travel of head is $10\frac{1}{2}$ inches. Hole through spindle is $3\frac{1}{4}$ inches.

Or it may be used as a single spindle machine, with a large chuck on the rear spindle, when it swings 17 inches.

THE FAY AUTOMATIC LATHE

An automatic machine for work held on centers, or carried on arbors. Particularly adapted to second operation work.

RANGE OF WORK. It swings 14 inches over the shears and 10 inches over the carriage. It will turn up to 10 inches in length. The movements are entirely automatic, the machine stopping itself when the work is completed.

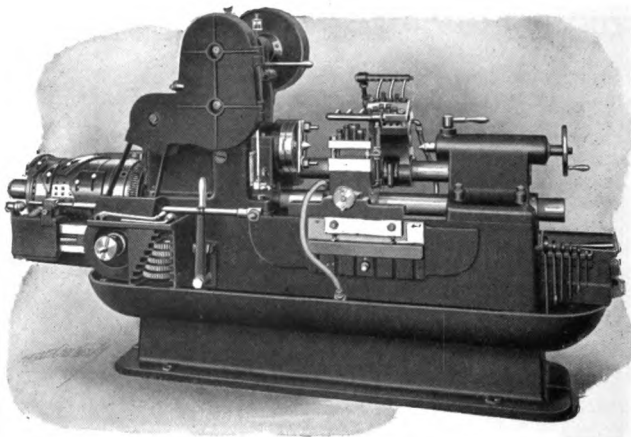
FEEDS. The movements of the various tools are controlled by adjustable cams. The camshaft has an adjustable quick drive for idle motions, and a slow drive through change gears for feeding.

CARRIAGE. The carriage, attached to the central shaft, has lateral motion obtained from cams on the drum. Movement in the vertical plane is given by removable formers, mounted on former slide and operated from the drum. These two movements may be made either separately or in conjunction.

BACK TOOL ARMS. The back tool holder is adjustable on the rear shaft and has a lateral motion controlled by the cam drum. Movement in the vertical plane is obtained from a separate heart cam. These movements may also be made separately or in conjunction.

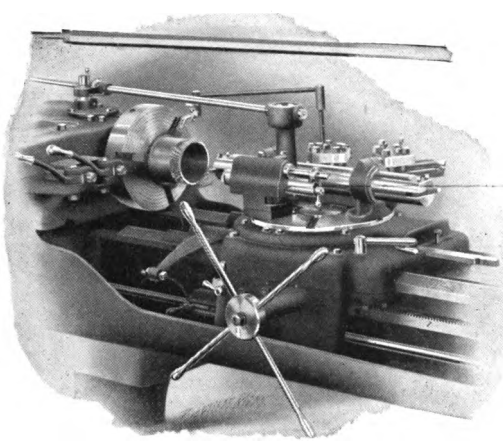
TAPER TURNING is effected by adjustment of the straight former on the former slide operating the carriage; for steep tapers, such as the faces of bevel gears, etc., a special bevel attachment is provided, controlling the back tool arm.

FORM TURNING in wide variety is also effected by formers operating the carriage. This is especially useful in crowning cone pulleys, etc.



JONES & LAMSON MACHINE CO.

UNIQUE EQUIPMENT FOR THREADING



AUTOMATIC CHASING ATTACHMENT

The Hartness Chasing Attachment is shown applied to the Flat Turret Lathe.

This attachment is automatic. The carriage is locked to the bed and the attachment clutched with its positive drive from the work spindle. The threading tool feeds forward at cutting depth under lead screw control until the tool bar strikes a stop. The tool is then withdrawn to clear the work and returned at high speed to the starting point, where it is again fed in to

cutting depth and engaged with the lead screw. The work spindle revolves continuously. The only motion required of the operator is that of adjusting the cross sliding head forward a slight amount during the return of the cutter to feed the tool in for the new cut. There is no possibility of overrunning and gouging into a shoulder, no matter how fast the machine is run.

The advantage of this attachment is that it gives engine lathe accuracy to turret lathe threading—and it gives much more than engine lathe speed.

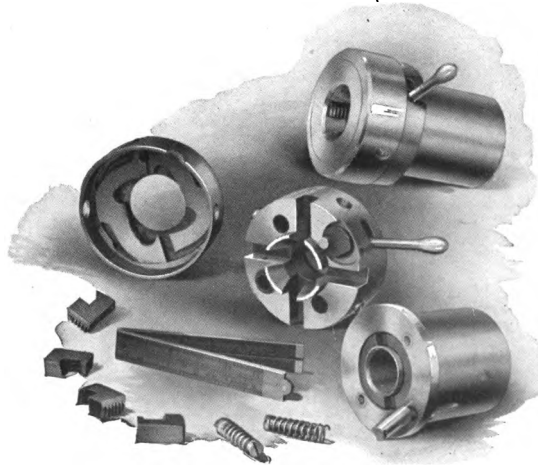
HARTNESS AUTOMATIC DIE

Wide Range Few Dies High Accuracy Small Expense

The No. 1 Die threads from $\frac{3}{32}$ inch to $\frac{1}{16}$ inch diameter, all pitches. The entire range from $\frac{1}{4}$ inch to $2\frac{3}{4}$ inch for standard threads, and to 3 inches for 8 pitch or finer, is covered by three sizes of dies whose ranges overlap.

Any of these dies, even the large No. 9, will thread pitches as fine as 32 per inch on its largest diameter without danger of stripping.

The lead-controlling feature is exclusive with this die. You can cut long threads as accurate in pitch as you will get from the ordinary engine lathe.



WINDSOR MACHINE COMPANY

WINDSOR, VERMONT, U. S. A.

FOREIGN OFFICE: 68 Ave. de la Grande Armee, PARIS, FRANCE

GRIDLEY AUTOMATICS; MULTIPLE SPINDLE—SINGLE SPINDLE

GRIDLEY SINGLE SPINDLE AND GRIDLEY MULTIPLE SPINDLE AUTOMATICS are designed for making parts from bars up to five and one-quarter inches in diameter. The tools used are held stiffly, close to their cutting point, and the simplicity of the set-up allows the widest range of tooling to be used.

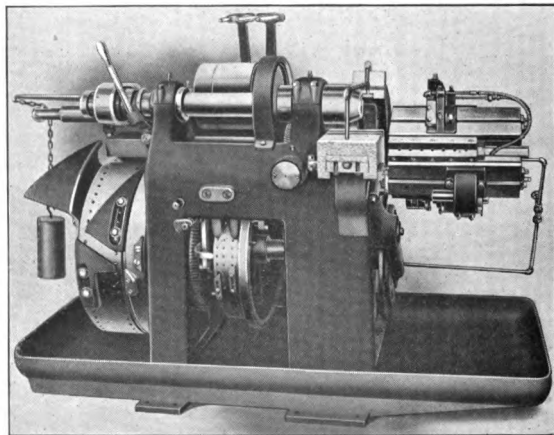
GRIDLEY SINGLE SPINDLE AUTOMATICS

Are built in four sizes, viz., 2 $\frac{1}{4}$ " , 3 $\frac{1}{4}$ " , 4 $\frac{1}{4}$ " , and 5 $\frac{1}{4}$ " with a capacity for handling bars not larger in diameter than their respective sizes imply and turning up to 12" in length.

They will make automatically from a bar of metal, anything within their capacity that can be made on any automatics, in addition handling work of greater length and more complex character.

The tools are supported close to the cutting edge and the absence of overhang gives them a rigidity which enables the operator to produce perfect work.

Many combinations of tools can be made on each slide, thereby doubling or trebling the work at one movement of the turret.



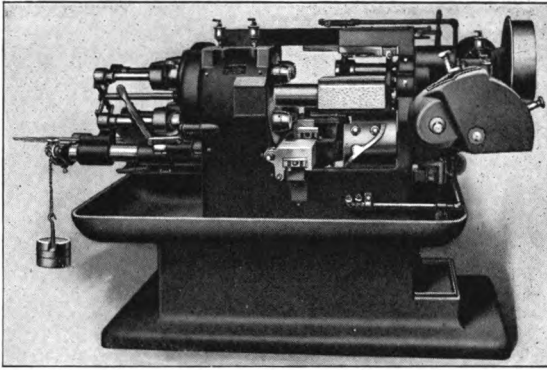
Single Spindle Automatic

WINDSOR MACHINE COMPANY

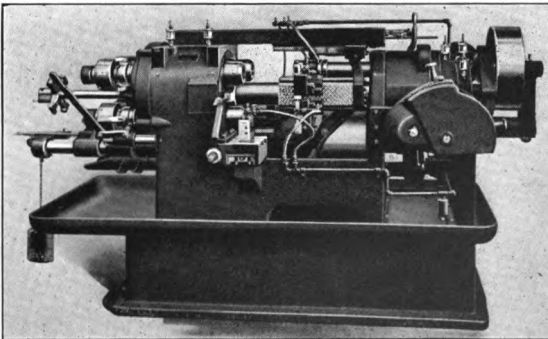
GRIDLEY MULTIPLE SPINDLE AUTOMATICS

Have four spindles, a single belt constant speed drive and a quick-change-gear feed box. They are made in four sizes with a maximum capacity for bars of $\frac{3}{4}$ ", $1\frac{1}{4}$ ", $1\frac{3}{4}$ ", and $2\frac{1}{4}$ " respectively, the $\frac{3}{4}$ " machine finishing work up to and including $5\frac{1}{2}$ " and the $2\frac{1}{4}$ " up to and including 7" in diameter.

The tool slide is mounted on an extension of the spindle carrier which insures the tools keeping in perfect alignment with the spindles.



$\frac{3}{4}$ " x $1\frac{1}{4}$ " Multiple Spindle Automatic



$2\frac{1}{4}$ " Multiple Spindle Automatic

THE WARNER & SWASEY COMPANY

CLEVELAND, OHIO

NEW YORK

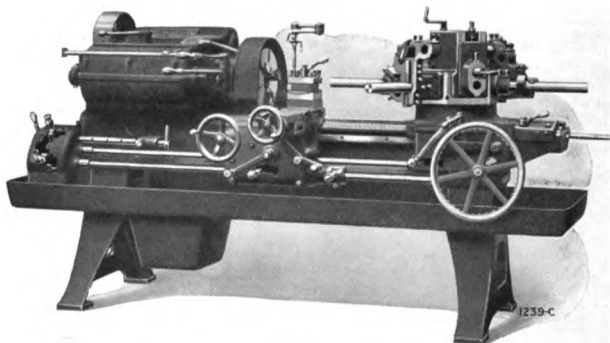
BOSTON

BUFFALO

DETROIT

CHICAGO

LONDON, ENGLAND



No. 2-A Universal Hollow-Hexagon Turret Lathe; Chucking Equipment

UNIVERSAL HOLLOW-HEXAGON TURRET LATHES

Two sizes: Automatic chuck capacity, $2\frac{1}{2}$ and $3\frac{1}{2}$ ", length turned, 29 and 40", chuck swing, $13\frac{1}{4}$ and $17\frac{1}{4}$ ". Bar and chucking equipments readily interchangeable.

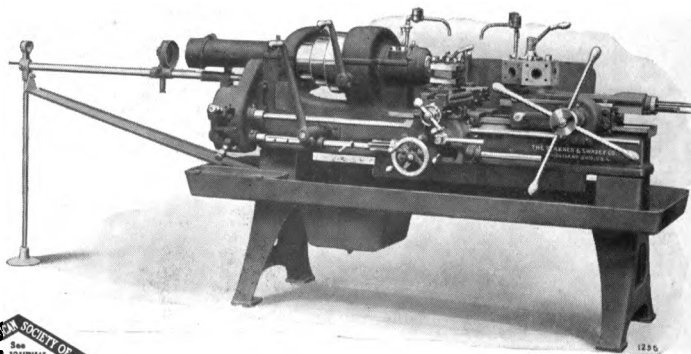
TURRET SCREW MACHINES

Five sizes, including the No. 4 Universal illustrated below, which has independent power feeds for turret and carriage, permitting two cuts at one time.

PLAIN, SET-OVER AND UNIVERSAL TURRET LATHES

BRASS-WORKING MACHINE TOOLS

Catalog describing the complete product in detail will be sent upon request. Equipments planned, output estimated.



No. 4 Universal Turret Screw Machine; Bar Equipment



T. C. DILL MACHINE COMPANY, INC.

PHILADELPHIA, PA., U. S. A.

BUILDERS OF SLOTTERS

THE "DILL SLOTTER"

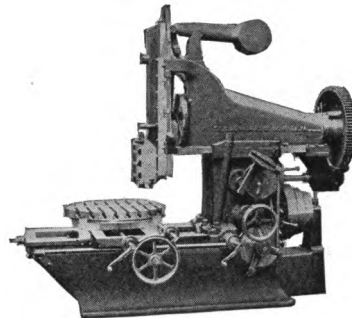
In the design of the "Dill Slotter," to meet the demands of today, it was plain that a departure was necessary and that procedure must be in at least two directions. First: that the machine must be able to produce a greater amount of work and that work must be more accurate. Second: that it must have a much greater range and not be confined only to the ordinary slotter work, but also reach out into other fields of usefulness; and, besides all this, it must be, if possible, more durable. The following features, which for the most part are exclusive, show how this Slotter meets the above requirements.

The GENERAL CONSTRUCTION of the "Dill Slotter" throughout is such as to insure efficiency and durability. It is constructed of the best material for the purpose; the gears are all cut from solid metal and mostly of forged steel; flat bearing surfaces are all hand-scraped to surface plates and are of ample dimensions. Gears, shafts, etc., are readily accessible for inspection. The convenience of operation is of special merit; while it is operative from one point principally, hand feeds are provided on all sides.

Attributes

- A Traveling Head**—Greatly increases the range of the machine.
- A Quick Traverse Gear**—A great time and labor saver.
- New Quick Return**—Permits high and uniform cutting speeds.
- New Intermittent Feed**—For feeding heavy work at high speeds.
- An Automatic Knock-Off**—A safety device for the feed mechanism.
- A Stroke Indicator**—Quite indispensable; nothing like it.
- A Hand Wheel Controller**—A good thing, and in the right place.
- A Tool Post in the Relief Apron**—Very handy in changing tools.
- Six Changes of Speed**—About four is the usual number.
- Belt and Motor Driven**—Designed for both; not a make-shift.
- Powerfully Geared**—About double the usual ratio.

15 Inch Slotter. Belt or Motor Driven.



Arranged for Belt Drive

195

PRINCIPAL DIMENSIONS

Size of machine, ins.	10	10-12	15	15-18	20	20-24
Maximum stroke, ins.	10½	12½	15½	18½	21	25
Longitudinal movement of table, in.	28	28	36	36	48	48
Transverse movement of table, in.	20	20	30	30	40	40
Diameter of table, in.	24	24	34	34	44	44
Movement of head, in.	15	15	21	20	30	30
From table to head, in.	12	12	19¼	19¼	24½	24½
Adjustment of ram, in.	16	16	23	23	32	32
Will cut to the center of circle of	54 in.	54 in.	72 in.	72 in.	92 in.	92 in.
Will cut to outside of circle of	54 in.	54 in.	90 in.	90 in.	108 in.	108 in.
Strokes of ram per minute, r.p.m.	11½-85	10-76	8-48	7-43	6-31	5½ to 27
Feed of table per stroke, in.	0.011	0.011	0.010	0.010	0.0069	0.0069
Circular feed per stroke at 12 in. dia. (in.)	to 0.154 to 0.154	to 0.187 to 0.187	to 0.187 to 0.187	to 0.187 to 0.187	to 0.138 to 0.138	to 0.138 to 0.138
Feed of head per stroke, in.	0.0187	0.0187	0.011	0.011	0.0055	0.0055
Ratio of gears from cone pulley shaft	to 0.261 to 0.261	to 0.261 to 0.261	to 0.196 to 0.196	to 0.196 to 0.196	to 0.11 to 0.11	to 0.11 to 0.11
Size of countershaft pulleys, in.	0.0055	0.0055	0.005	0.005	0.00345	0.00345
Speed of countershaft, r.p.m.	to 0.077 to 0.077	to 0.077 to 0.077	to 0.093 to 0.093	to 0.093 to 0.093	to 0.069 to 0.069	to 0.069 to 0.069
Horsepower of motor	12 to 1	12 to 1	18 to 1	18 to 1	24 to 1	24 to 1
Speed of constant speed motor, r.p.m.	14 x 3½	14 x 3½	20 x 4	20 x 4	26 x 5	26 x 5
Speed of variable speed motor, r.p.m.	200	180	200	180	200	180
Net weight, lbs.	3	3	5	5	10	10
	1,200	1,000	1,200	1,000	1,200	1,000
	400 to	400 to	400 to	400 to	400 to	400 to
	1,200	1,200	1,200	1,200	1,200	1,200
	5,000	5,250	10,000	10,500	23,000	24,000

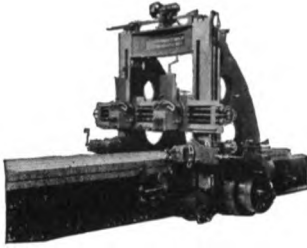
THE CINCINNATI PLANER CO.

OAKLEY, CINCINNATI, OHIO

PLANERS & BORING MILLS

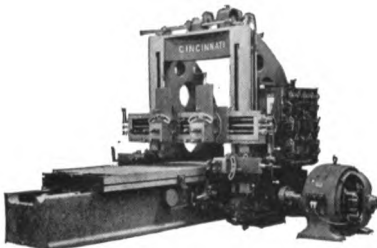
CINCINNATI PLANERS

Cincinnati Planers are designed for strength, rigidity, durability, convenience in operation and adaptability for all classes of work required of a planer.



Standard Planer

Standard Planers are made in all sizes from 22" to 96". THE BEDS are of a heavy deep box section and are especially strengthened where the gearing and uprights are mounted. THE TABLES are of unusual thickness and are braced at short intervals with heavy ribs, thus preventing any possibility of springing under any circumstances. CROSS RAILS are of great depth, and have an extra deep box brace on the back. THE HEADS are distinctive, the ends of tool blocks and slides being made round. THE GEARING AND RACK are of extra wide face—all the large gears and racks being made from semi-steel castings and the pinions from steel forgings.



Reversible Motor Driven Planer

Widened Planers: There is a great variety of planing which does not require a standard machine and in many cases a widened planer will do the work better, as it is easier to handle and capable of higher speeds. We build these planers to suit your work, and have patterns for the various sizes given.

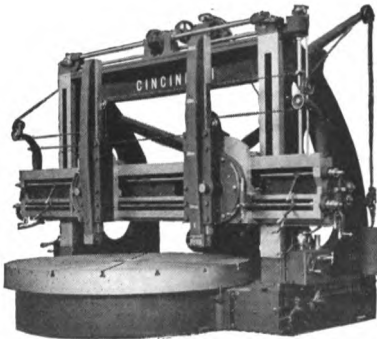
Sizes—34"x24", 36"x30", 42"x36", 48"x36",
56"x42", 60"x48", 72"x56", 96"x72".

Variable Speed Planers: The greatest possible gain in planing comes from access to a change of cutting speeds. A correct speed for all materials and conditions, instantly available, is the secret of economy in planing. Our variable speed planers are arranged for ten cutting speeds and ten return speeds.

Motor Driven Planers: All Cincinnati Planers may be arranged for motor drive.

CINCINNATI BORING MILLS

These mills are made in sizes of 6', 7', 8', 10', 12', 14' and 16'.



Standard Boring Mill

General Description: THE BED is of deep box form throughout. All parts are thoroughly ribbed and braced and the entire mechanism of the mill is supported on the bed. THE TABLE is large in diameter and supported on a broad flat annular bearing of a large diameter. THE MAIN DRIVING GEAR is an internal gear cut from the solid. THE HOUSINGS are of massive box form, a wide and long base insuring rigidity under the most severe duty. THE CROSS RAIL is of box form and has a deep arch on the back so that any deflection due to weight of heads or pressure of the cut is reduced to a minimum. THE HEADS have the narrow guide bearing at bottom of rail, which prevents all tilting or binding while heads are under cutting strain. EIGHT DIFFERENT FEEDS are provided ranging from 1-32" to 1".

THE FELLOWS GEAR SHAPER CO.

SPRINGFIELD, VERMONT, U. S. A.

MANUFACTURERS OF GEAR SHAPERS AND GEAR SHAPER CUTTERS

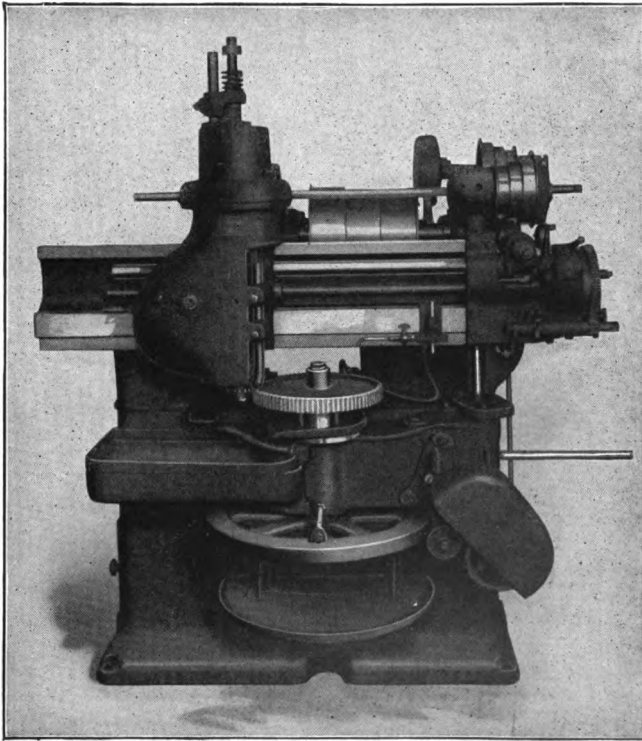
THE FELLOWS GEAR SHAPER

In the Gear Shaper System a generating cutter is used, only one being required for any number of teeth of a given pitch. This cutter is first hardened and then all distortion and inaccuracies are ground away, the teeth, when finished, having been brought to the correct involute.

The No. 6 Gear Shaper cuts external spur gears of 35 inches diameter, 5 inches face, 4 diametral pitch, and internal spur gears of 26 inches pitch diameter, 3 inches face, 4 diametral pitch.

The No. 3 machine cuts external spur gears of 24 inches diameter, 4 inches face, 6 diametral pitch in cast iron, 7 pitch in steel.

The No. 65 Helical Gear Shaper cuts helical gears up to 35 inches diameter, 5 inches face, 6 pitch.



No. 6 Gear Shaper

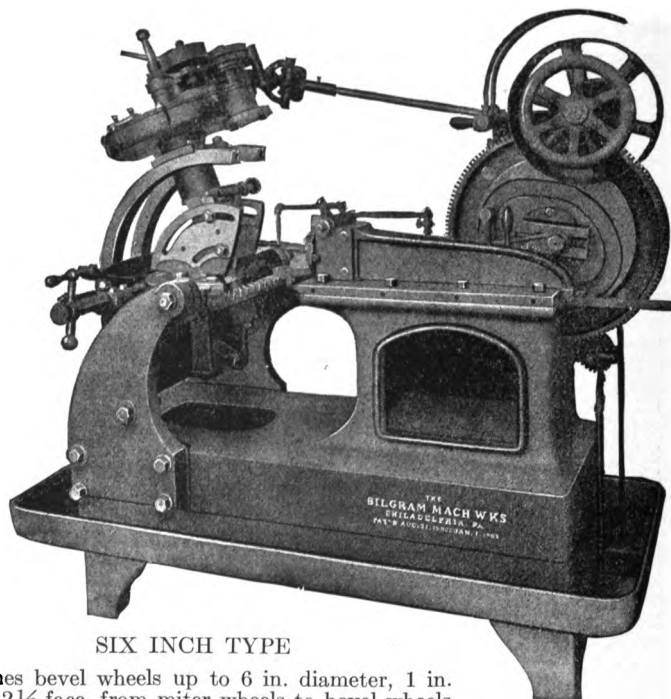
THE BILGRAM MACHINE WORKS

1237 SPRING GARDEN ST.

PHILADELPHIA, PA.

MAKERS OF SPECIAL MACHINERY. NORMAL AND HELICOIDAL BEVEL GEARS CUT THEORETICALLY CORRECT. SPECIAL FACILITIES FOR CUTTING SPUR, WORM, SPIRAL AND INTERNAL GEAR WHEELS

THE BILGRAM BEVEL GEAR GENERATOR



SIX INCH TYPE

Planes bevel wheels up to 6 in. diameter, 1 in. pitch, $2\frac{1}{2}$ face, from miter wheels to bevel wheels of proportion one to six.

Floor Space.....3 ft. 10 in. x 2 ft. 3 in.

Net weight of machine.....1600 lbs.

Net weight of countershaft, cone sectors,
etc.....400 lbs.

Gross weight.....2700 lbs.

SIXTEEN INCH TYPE

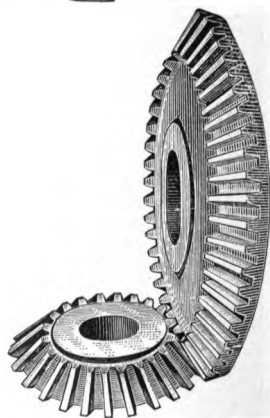
Planes bevel wheels up to 16 in. diameter, 2 in. pitch, 6 in. face from miter wheels to bevel wheels of proportion one to four.

Floor space.....6 ft. 1 in. x 2 ft. 8 in.

Net weight of machine.....3850 lbs.

Net weight of machine, countershaft, cone
sectors, etc.....850 lbs.

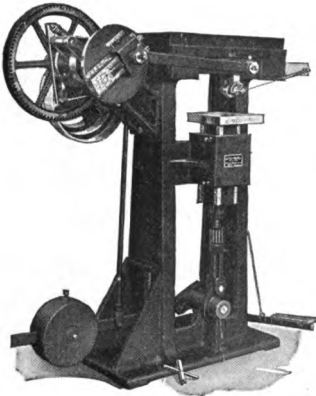
Gross weight.....6100 lbs.



NOBLE & WESTBROOK MFG. CO.

HARTFORD, CONN., U. S. A.

MANUFACTURERS OF DWIGHT SLATE MARKING MACHINES, MARKING DEVICES OF EVERY DESCRIPTION, EXPERT DIE CUTTING AND ENGRAVING



No. 11 Power Marker

DWIGHT SLATE MARKING MACHINE

These Machines will Mark Artistically Any Article or Any Material Suitable for Impressions

A specialty of our line of manufacture is the making of devices and machines for placing on flat or round metal surfaces, impressions of trade-marks, patent dates, graduated scales and a variety of similar work. These machines are not expensive, are adapted to the work, do it in a superior manner at less cost than is possible on any makeshift devices.

A neat mark is desirable, adds to appearance of goods, and is a feature that the manufacturer cannot afford to ignore. Goods of all kinds are put on the market in more tasty and improved form than a few years since.

Both trade and purchasers call for these qualities. Antiquated and clumsy designs that were "good enough" are rapidly being displaced by improved forms and finish. By using modern machinery this is done at saving of original cost; therefore, when we offer better work at less cost we ask its consideration. Samples or sketches of work are solicited, proper machines recommended, and complete outfits furnished.

DIE CUTTING BY EXPERT ENGRAVERS

For These Machines a Specialty

We have a large force of expert engravers familiar with the die cutting for these machines and in order to get the best results, we would recommend that you send us samples and let us furnish you the first equipment of dies and fixtures.

Special Marking Machines Made to Order

We are in a position to furnish special Marking Machines for various kinds of work such as extra heavy marking where it is required to mark from ten to twelve lines of $\frac{1}{8}$ -inch lettering; also where extra large articles are to be marked.

Or for Numbering and Graduating

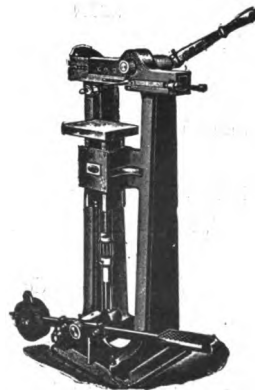
Fuse Caps, Micrometer Collars on Lathes,

Milling Machines, Etc.

also Special Machine for

Marking Chucks

Take your troubles up with us and we will solve them for you.



No. 3 Hand Marker

LANDIS TOOL COMPANY

WAYNESBORO, PA.

PRECISION CYLINDRICAL GRINDING MACHINES

Our regular line consists of the following types:

UNIVERSAL MACHINES No. 1, No. 1½, No. 2, No. 3, No. 4. (Nos. 2, 3, and 4 are also built with 16"-swing,) are used for finishing tools and a variety of straight or taper parts, both external and internal, such as are common to the toolroom, machine shop, railroad shops, etc.

Attachments, such as magnetic chuck, gear-cutter attachment, side mill grinding attachment, etc., can be used on these machines to advantage.

PLAIN GRINDING MACHINES. Sizes 6", 10", 12", 20", 30", 40" swings in standard lengths. These strictly manufacturing machines are intended for finishing straight and taper spindles, shafts, rolls, tubing and all other work which can be revolved on dead centers.

PLAIN GRINDING MACHINES WITH GAP are our 16" and 20" swing. Plain Machines, built with gap in the bed to suit the location of the projection on the work. Especially suitable for grinding locomotive piston rods.

INTERNAL GRINDING MACHINE for straight and taper internal grinding and the fixtures for these machines will grind holes ¼" diameter, or larger, and up to 12" long.

CRANK GRINDING MACHINE for grinding single or multiple throw crank shafts used in gas and small steam engines.

ROLL GRINDING MACHINES for grinding chilled iron and hardened steel rolls.

CAM GRINDING ATTACHMENTS (for use on our plain and universal grinders) for grinding either detachable or integral cams.

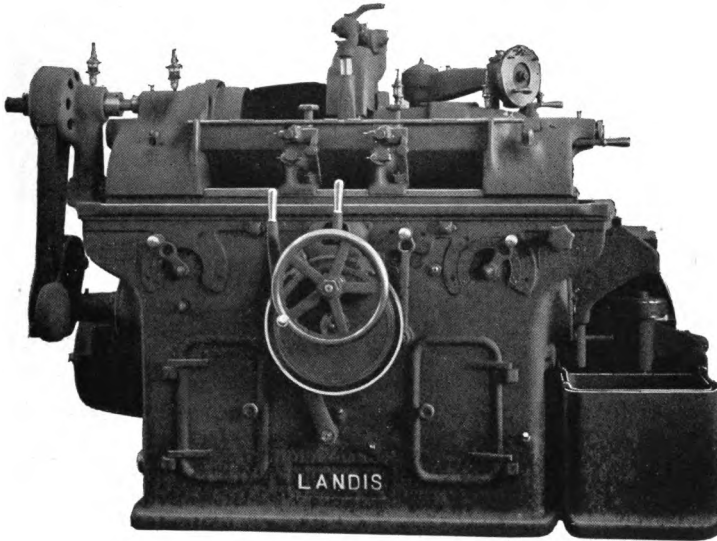
BALL BEARING RACE GRINDING MACHINE for grinding the raceways in radial, thrust and cone ball bearings.

Our illustrated and descriptive catalogue and literature gives detailed information. It also describes the features which stand for quick manipulation, accurately finished work, durability of alignments and rapid production—all of which are prominent in the various types of Landis Grinding Machines.

LANDIS TOOL COMPANY

LANDIS

IMPROVED SELF-CONTAINED GRINDING MACHINE



201

Central control—increases efficiency of the operator.

Variety of independent work and traverse speeds, suitable for rapid removal of stock or vice versa for finish.

Hand or automatic feed of wheel to work.

Sizing device which automatically stops feeding of wheel to work, permitting operator to prepare work during grinding operation.

Work rests with independent horizontal and vertical adjustments having stops which can be quickly set for grinding duplicate work.

Positive quick-setting traverse reversing dogs, requiring no wrenches or screw drivers.

Tarry device—adjustable to suit the respective work and traverse speeds.

Ample water circulation. Interchangeable wheel centers.

Massive construction insures rigidity and durability.

Chilled surfaces secures permanency of alignments.

Special-treated accurately ground wheel spindle uniformly lubricated, bys ight-feed oilers, through helical grooves.

Large bronze bearings with taper adjustments for wear and so designed to self-compensate for any heat expansion.

Work table firmly clamped to main body of machine and always entirely free from any overhang.

All gearing fully enclosed.

The grinding wheel carriage—a fixed weight—is the moving member.

Send for illustrated literature.

MODERN TOOL COMPANY

ERIE, PENNA., U. S. A.

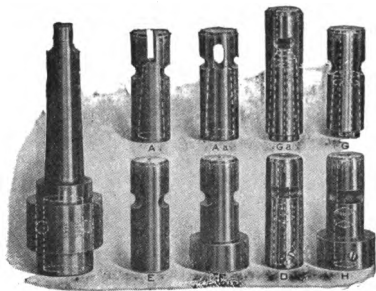
**PLAIN, UNIVERSAL AND INTERNAL GRINDING MACHINES, SELF
OPENING DIES, COLLAPSIBLE TAPS AND QUICK CHANGE CHUCKS**

"MODERN" SELF OPENING DIES AND COLLAPSIBLE TAPS

"Modern" Threading Tools are universal in their application and use, being adapted for revolving spindles as well as turret lathes and screw machines. A single style of Die or Tap will cut any form or pitch of thread, of any diameter within the capacity of the respective heads. "Modern" Die Heads are made in sizes to thread any diameter from $\frac{1}{16}$ " to 6", and the range of "Modern" Collapsible Taps is from $\frac{1}{2}$ " to $2\frac{3}{4}$ ".



"Modern" Self Opening Die



"Magic" Chuck and Collets

"MAGIC" CHUCK EQUIPMENT

For the rapid changing of tools in drill press, lathe, screw machine, etc., without stopping the machine, practically converting a single spindle machine into a multiple spindle one, with as many tools as you may have operations. Made in six sizes, the largest with capacity up to 5" diameter drills. Try it and save labor costs.

"MODERN" GRINDING MACHINES

"Modern" Self-Contained Grinding Machines have a single constant speed drive, which reduces the cost when equipping the machines with motors. The main drive is in the rear of the machine and power is applied either from the line shaft by a single belt or by motor connection.

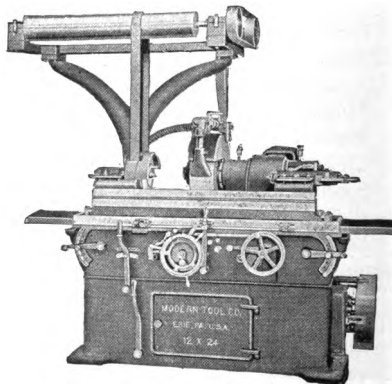
"Modern" Plain Type, Self-Contained Grinding Machines are made in sizes ranging in capacity from 24" to 60" between centers, and up to 16" swing.

"Modern" Self-Contained Crank Grinding Machines are adapted for grinding and finishing single and multiple throw crank shafts, including those used in the manufacture of gas engines or motors for automobiles and launches.

The above types are strictly manufacturing machines, designed to withstand the class of service required of grinding machines of this character, and embody many new and improved features which enable them to produce accurate, highly finished parts, rapidly and economically.

"Modern" Universal Type Grinding Machines, external and internal in combination, offer the widest range in the tool room and factory.

Send for illustrated literature.



"Modern" 12"x24" Plain Self-Contained Grinding Machine

IDEAL TOOL & MANUFACTURING CO.

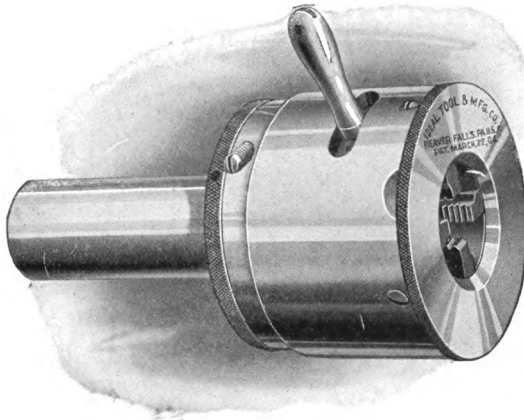
BEAVER FALLS, PA.

MANUFACTURERS OF SCREW CUTTING DIES**THE IDEAL OPENING DIE**

Six loose parts, all parts subject to wear, are hardened, such as CAM-HEAD holding Chasers and CLUTCH, thereby eliminating to a great degree the tendency to wear.

Chasers supported directly back of cutting edge, which eliminates tapered threads.

Revolving HEAD instead of CAM, which utilizes belt power or cutting strain, as an opening power.



Send prints or samples of work, and we shall be pleased to give full information, regarding same.

Dies sent on trial, subject to your inspection, and if not satisfactory, can be returned without any expense to yourselves.

SIZE	$\frac{1}{4}$ Inch	$\frac{1}{2}$ Inch	$\frac{3}{4}$ Inch	1 Inch	$1\frac{1}{4}$ Inch	2 Inch
Diameter of head.....	$1\frac{1}{8}"$	$2\frac{1}{8}"$	$3\frac{1}{8}"$	$3\frac{3}{8}"$	$4\frac{1}{8}"$	$6\frac{3}{8}"$
Length of head.....	$1\frac{3}{8}"$	$1\frac{7}{8}"$	$2\frac{1}{2}"$	$2\frac{3}{4}"$	$3\frac{1}{2}"$	$4\frac{1}{4}"$
Diameter of shank.....	$\frac{5}{8}$ or $\frac{3}{4}"$	$\frac{7}{8}$ or $1\frac{1}{8}"$	$1\frac{1}{4}$ or $1\frac{1}{2}"$	$1\frac{1}{2}$ or $1\frac{3}{4}"$	$1\frac{3}{4}$ or $2\frac{1}{4}"$	3 or $3\frac{1}{2}"$
Length of shank.....	2"	$2\frac{1}{2}"$	3"	4"	$4\frac{1}{4}"$	5"
Length over all.....	$3\frac{3}{8}"$	$4\frac{3}{8}"$	$5\frac{1}{2}"$	$6\frac{3}{4}"$	$7\frac{3}{4}"$	$9\frac{1}{4}"$
Capacity.....	$\frac{1}{4}$ to $\frac{1}{2}"$	$\frac{1}{2}$ to $\frac{3}{4}"$	$\frac{3}{4}$ to $1"$	$\frac{1}{2}$ to $1"$	$\frac{1}{2}$ to $1\frac{1}{4}"$	1 to 2"
Chasers in set.....	4	4	4	4	4	4
With 1 set of chasers....	\$25.00	\$30.00	\$40.00	\$50.00	\$65.00	\$95.00
Extra shanks, each.....	4.00	5.00	6.00	7.00	8.00	10.00
Standard chasers, per set.	1.25	1.50	2.00	2.50	3.00	4.00
Special.....	2.00	2.50	3.00	3.50	4.00	5.00
H. S. Steel extra.....	1.00	1.00	1.00	1.00	1.00	1.00

One set of Standard pitch chasers, either U. S. V. or Whitworth, right or left hand furnished with die.

When ordering, always specify material to be cut.

Information regarding Dies above 2 in. capacity will be given upon request.

THE VAN DORN AND DUTTON CO.

GEAR SPECIALISTS

THE VAN DORN ELECTRIC TOOL CO.

ELECTRIC TOOL SPECIALISTS

GENERAL OFFICES AND FACTORIES

CLEVELAND, O.



GEARS & GEAR CUTTING

The Van Dorn & Dutton Co. specialize in gearing, and are prepared to furnish cut and planed gears of all descriptions, for every class of service,—to your specifications.

Our output includes spurs, bevels, mitres, spirals, worms, racks, etc.

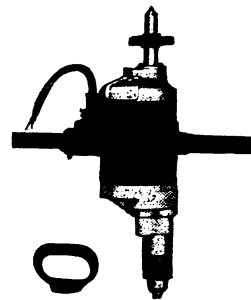
A thoroughly equipped hardening and steel treating plant is maintained exclusively for our gear production.

VAN DORN "HARD SERVICE" (PORTABLE) ELECTRIC DRILLS AND REAMERS

Made in various speeds for rapid production on bridge, structural and car reaming, general drilling, etc.

110-220 and 250 volt machines carried in stock.

The motors employed are of the straight series type, designed to withstand a 50% overload. Ball bearings are used on both ends of the armature shaft, ball type thrust bearings, hardened and ground gears with accurately generated teeth, quick make and break switches and forced lubrication in lower head.



DIRECT CURRENT MACHINES

Type	CAPACITY STEEL		Weight	E. H. P.
	Drilling	Reaming		
D. C. 1	$\frac{1}{2}$ "	$\frac{1}{4}$ "	22 lbs.	.73
D. C. 2	$\frac{5}{8}$ "	$\frac{1}{2}$ "	28 "	1.32
D. C. 2x	$\frac{7}{8}$ "		38 "	1.47
D. C. 3x	1"		40 "	2.07
D. C. 3	$1\frac{1}{2}$ "	$\frac{3}{4}$ "	69 "	2.95
D. C. 4	$1\frac{1}{2}$ "	$1\frac{1}{4}$ "	75 "	2.95
D. C. 5	2"	$1\frac{1}{2}$ "	105 "	4.43

Supplied with cable ready to attach to line. $\frac{1}{2}$ " machines supplied with chucks when wanted. $\frac{5}{8}$ " machines and larger supplied with Morse taper sockets.

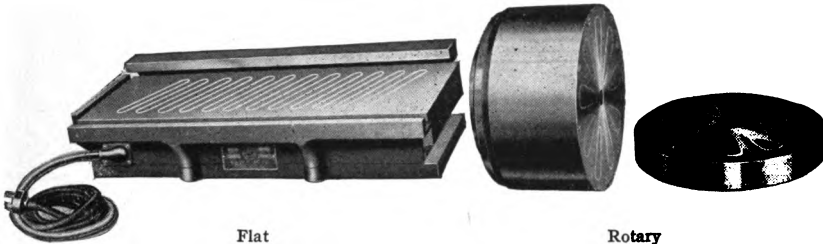
We also carry in stock universal machines for operation on D.C. and A.C. in $\frac{3}{8}$ ", $\frac{1}{4}$ ", $\frac{5}{16}$ ", $\frac{3}{8}$ ", $\frac{1}{2}$ ", $\frac{5}{8}$ ", $\frac{7}{8}$ ", and 1" capacities.

D & W FUSE COMPANY

PROVIDENCE, R. I.

"D & W" MAGNETIC CHUCKS

Oil-Proof and Waterproof



Flat

Rotary

"D & W" magnetic chucks are so designed as to make possible a wider range of work than has heretofore been considered practicable. This is affected by the use of a special form of narrow pole pieces made of mild steel. With this design a maximum effective holding surface is secured together with an exceptionally strong and uniform pull throughout.

The magnet coils in "D & W" chucks are wound with Deltabeston wire, having a special heatproof insulation of pure asbestos, which we manufacture. This insulation can safely withstand temperatures as high as 400° Fahr. In addition, the coils are wound by a special process which further protects them from heat and moisture. This eliminates the expense of burnt out coils.

The flat chucks are equipped with adjustable end and side stops, providing convenient means for locating and steadying the work on the surface of the chucks.

The above illustration of the rotary chuck shows same with an auxiliary plate. These plates are used as jigs or fixtures for the holding of special or irregular shaped pieces. By means of these plates, one chuck can be made to cover a wide range of operations, as any number of plates can be used with one chuck. All chucks are designed to operate on direct current circuits up to 250 volts. Voltage of line should be specified in ordering.

Magnetic chucks can only be operated on direct current circuits.

Complete catalogue mailed upon request.

FLAT

Style	Extreme Holding Face	Extreme Base Dimension	Height	Price Each
F- 7- 8	8¾ x 7	8¾ x 6	4	\$50.00
F- 5-13	13 x 5¾	13 x 4½	3½	50.00
F- 7-16	16¾ x 7	16¾ x 6½	3½	70.00
F- 8-20	20½ x 9½	20½ x 8	3½	100.00
F-10-31	31½ x 10½	31½ x 9½	4½	135.00
F-13-21	21 x 13½	21 x 12	4½	120.00
F-13-33	33½ x 13½	33½ x 12	4½	160.00
F-10-46	46½ x 10½	46½ x 9½	4½	Special

ROTARY

Style	Diameter	Width to Face Plate Seat	Diam. of Each Plate Seat	Price Each
R- 3	4½	2½	5 Morse Taper	\$30.00
R- 6	6	3½	4	40.00
R- 8	8	3½	4½	50.00
R-10	10	3½	5	65.00
R-12	12	4½	5	85.00
R-14	14	4½	7	Special
R-16	16	4½	7	"
R-18	18	4½	8	"
R-20	20	4½	8	"
R-24	24	5	10	"

In ordering chucks specify the voltage of lighting circuit.

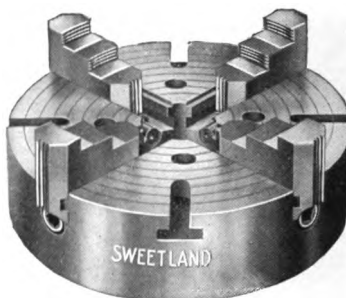
THE HOGGSON & PETTIS MFG. CO.

NEW HAVEN, CONN., U.S.A.

THE SWEETLAND INDEPENDENT CHUCKS

PRICE LIST, DIMENSIONS, ETC.

Code	Size	Size of Hole	Diameter of Recess for Face Plate	Weight	Price
fable	4½ in.	1 in.	4½ in.	7 lbs.	\$ 14 00
fabric	6 in.	1½ in.	5½ in.	12 lbs.	18 00
facade	8 in.	1¾ in.	4¾ in.	28 lbs.	22 00
facile	9 in.	1¾ in.	5½ in.	32 lbs.	24 00
facet	10 in.	2 in.	5½ in.	42 lbs.	26 00
faction	12 in.	2½ in.	6½ in.	67 lbs.	30 00
faculty	14 in.	3 in.	6½ in.	84 lbs.	34 00
fagot	16 in.	3 in.	7½ in.	117 lbs.	38 00
faish	18 in.	4 in.	9½ in.	157 lbs.	44 00
falcon	20 in.	4½ in.	9½ in.	184 lbs.	50 00
fame	22 in.	5 in.	11 in.	217 lbs.	57 00
fancy	24 in.	5 in.	11 in.	247 lbs.	65 00
fashion	26 in.	5 in.	12 in.	315 lbs.	80 00
fastness	28 in.	5 in.	13 in.	350 lbs.	100 00



DIMENSIONS

OF ALL

GEARED SCROLL CHUCKS

Numbers 6, 60, 61, 62, 63, 64, 65 and 66

Size	Net Weight Approx. 1 Set Jaws		Gross Weight Approx. 1 Set Jaws		Net Weight Jaws Per Set		Size of Hole	Diameter of Recess for Face Plate	Will Hold	Diameter of Swing
	3 Jaws	4 Jaws	3 Jaws	4 Jaws	3 Jaws	4 Jaws				
2½	.....	.....	2	.....	.....	.....	1	1½	2½	2½
3	.....	.....	3½	4	.....	.....	1	2½	3½	3½
4	7½	7½	7½	7½	1	1	3	4½	4½	4½
5	10½	11	11	11½	1½	1½	1½	3½	5½	5½
6	16½	16½	17½	17½	1½	3	1½	4½	6½	6½
7½	26	28½	29	31½	3	4	2	4½	8½	8½
9	38	40	41	46½	3½	5½	2½	5	10½	10
10½	53	53½	61	61½	5½	7½	3	5½	11½	11½
12	69	73½	81	85	8	11½	3½	6½	13	12½
15	114	117	128	131	8	12	3½	6½	16	15½

REVERSIBLE JAWS ARE STYLES No. 6 and 60
COMMON " " " No. 61 and 62
REVERSE " " " No. 63 and 64

THREE JAW CHUCKS Styles No. 6, 61, 63

Code	Size	Price
ingot	2½ in.	\$ 7 50
inhale	3 in.	10 00
inlet	4 in.	12 00
install	5 in.	15 00
issue	6 in.	18 00
inward	7½ in.	20 00
inveigh	9 in.	24 00
insect	10½ in.	27 00
insight	12 in.	30 00
insipid	15 in.	40 00

FOUR JAW CHUCKS Styles No. 60, 62, 64

Code	Size	Price
inlaid	3 in.	\$10 75
inmate	4 in.	13 00
inmost	5 in.	16 20
indorse	6 in.	19 50
induce	7½ in.	21 00
indulge	9 in.	26 00
incense	10½ in.	29 10
india	12 in.	32 40
indigo	15 in.	43 30

TWO SETS OF JAWS ARE STYLES No. 65 and 66

THREE JAW CHUCKS Style No. 65

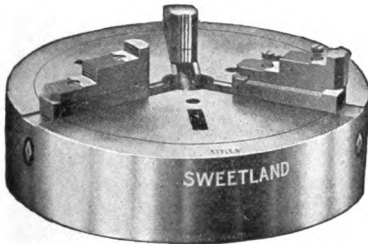
Code	Size	Price
ingulf	2½ in.	\$ 9 00
inject	3 in.	12 00
insist	4 in.	14 40
instep.	5 in.	18 00
iris	6 in.	21 60
invest	7½ in.	24 00
inverse	9 in.	28 80
intrude	10½ in.	32 40
inform	12 in.	26 00
infect	15 in.	48 00

FOUR JAW CHUCKS Style No. 66

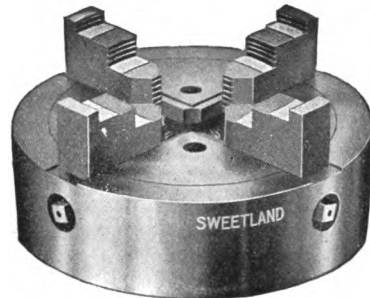
Code	Size	Price
incase	3 in.	\$13 35
inboard	4 in.	16 20
incage	5 in.	20 20
incise	6 in.	24 30
inclose	7½ in.	26 90
incline	9 in.	32 40
incrust	10½ in.	36 40
incur	12 in.	40 40
incurvate	15 in.	54 00

THE HOGGSON & PETTIS MFG. CO.

SWEETLAND COMBINATION LATHE CHUCKS



WITH REVERSIBLE JAWS



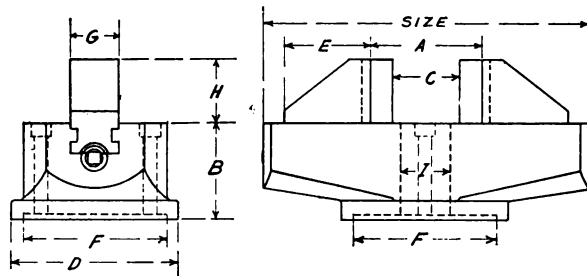
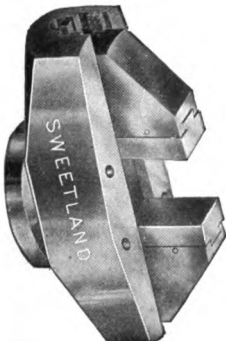
WITH COMMON JAWS

These Chucks Can Be Furnished From Stock
With Three or Four Jaws as Desired

Size	Net Weight Approx.		Gross Weight Approx.		Diameter or Swing	Will Hold	Size	Diameter of Recess for Face of Plate	Price List	
	3 Jaw	4 Jaw	3 Jaw	4 Jaw					Three Jaw	Four Jaw
Ins.	Lbs.	Lbs.	Lbs.	Lbs.	Ins.	Ins.	Ins.	Ins.		
4	7	....	9	....	5½	4½	1	3	\$ 22 00	\$
6	20	21	23	24	8	6½	1¼	3⅝	26 00	32 00
9	33	36	41	44	10½	9½	1½	5	34 00	42 00
12	60	65	73	78	13¾	12¼	1¾	5⅞	44 00	56 00
15	80	84	94	98	16¼	15¼	1¾	5⅞	52 00	64 00
18	110	116	129	135	19	18½	2	9	62 00	75 00
21	125	147	148	168	22¾	21½	2¼	9	80 00	95 00
24	145	162	170	187	25¾	24½	2½	9	100 00	120 00
30	332	383	379	430	32	30½	4½	12⅞	170 00	200 00
36	465	529	484	540	38½	36½	4½	12⅞	230 00	285 00
42	610	640	675	700	44½	42½	4½	24	270 00	325 00

THE SWEETLAND BOX BODY CHUCK

Can be furnished as Universal
or Independent. Slip Jaws
Tool or Soft Steel



Size	Weight each	A	B	C	D	E	F	G	H	I	Code	Price
in.		in.	in.	in.	in.	in.	in.	in.	in.	in.		
5	14 lbs.	1¾	2¾	½	5	1½	3	1½	1½	1	each	\$16.00
6	17 lbs.	2	3	½	4½	2	3½	1½	1½	1½	each	20.00
7	20 lbs.	3	3	1½	4½	2	3½	1½	1½	1½	each	24.00
9½	38 lbs.	4	3½	2¼	5½	2½	4½	2	2½	2	each	30.00
12	50 lbs.	6	3¾	4	6	3	5	2½	2½	2½	each	36.00
15	75 lbs.	8	4½	6	7½	3½	6	2½	3	2½	each	42.00
18	100 lbs.	10	4½	8	7½	4	6½	2½	3½	2½	each	60.00

THE CINCINNATI BALL CRANK CO.

CINCINNATI, OHIO

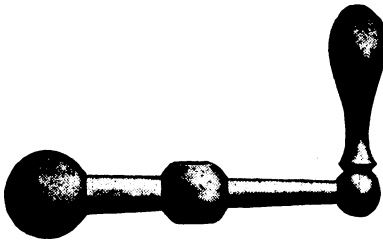
STEEL PRODUCTS

HANDLES FROM STEEL

For power tools and similar purposes

Milled from the bar, drilled, faced and key-wayed to specifications. Highly finished, accurate, complete on receipt and ready to attach.

STEEL BALL CRANK MACHINE HANDLES



No.	Length Over All	Center Ball	Large End Ball	Small End Ball
0	3	$\frac{7}{8}$	1	$\frac{5}{8}$
1	$3\frac{1}{2}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$\frac{5}{8}$
$1\frac{1}{2}$	4	$1\frac{1}{4}$	$1\frac{1}{4}$	$\frac{5}{8}$
2	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$\frac{5}{8}$
3	5	$1\frac{3}{4}$	$1\frac{3}{4}$	$\frac{5}{8}$
4	$5\frac{1}{2}$	$1\frac{7}{8}$	$1\frac{7}{8}$	$\frac{5}{8}$
5	6	$1\frac{7}{8}$	$1\frac{7}{8}$	$\frac{5}{8}$
6	$6\frac{1}{2}$	$1\frac{7}{8}$	$1\frac{7}{8}$	$\frac{5}{8}$
7	7	$1\frac{7}{8}$	$1\frac{7}{8}$	$\frac{5}{8}$
8	$7\frac{1}{2}$	$1\frac{7}{8}$	$1\frac{7}{8}$	$\frac{5}{8}$
9	8	$1\frac{7}{8}$	$1\frac{7}{8}$	$\frac{5}{8}$
10	$8\frac{1}{2}$	$1\frac{7}{8}$	$1\frac{7}{8}$	$\frac{5}{8}$
11	9	$1\frac{7}{8}$	$1\frac{7}{8}$	$\frac{5}{8}$
12	11	$1\frac{7}{8}$	$1\frac{7}{8}$	$\frac{5}{8}$
13	13	$1\frac{7}{8}$	2	$1\frac{1}{4}$

Center ball can be drilled and
faced any size desired.

No.	Length Over All	Center Ball	End Balls	
1	$2\frac{1}{2}$	1	$\frac{3}{4}$	No handle in ends
2	$2\frac{1}{2}$	1	$\frac{3}{4}$	Handle in one end
3	$2\frac{1}{2}$	1	$\frac{3}{4}$	Handle in both ends
4	3	1	$\frac{3}{4}$	No handle in ends
5	3	1	$\frac{3}{4}$	Handle in one end
6	3	1	$\frac{3}{4}$	Handle in both ends
7	$3\frac{1}{2}$	1	$\frac{3}{4}$	No handle in ends
8	$3\frac{1}{2}$	1	$\frac{3}{4}$	Handle in one end
9	$3\frac{1}{2}$	1	$\frac{3}{4}$	Handle in both ends
10	4	1	$\frac{3}{4}$	No handle in ends
11	4	1	$\frac{3}{4}$	Handle in one end
12	4	1	$\frac{3}{4}$	Handle in both ends

Center ball can be drilled and
faced any size desired.

COMPOUND REST HANDLES



MACHINE HANDLES



No.	Length of Shank	Length Over All	Diameter of Shank
000	$\frac{1}{2}$	$1\frac{1}{2}$	$\frac{1}{4}$
00	$\frac{1}{2}$	2	$\frac{1}{4}$
0	$\frac{1}{2}$	$2\frac{1}{4}$	$\frac{1}{4}$
1	$\frac{5}{8}$	$2\frac{1}{2}$	$\frac{3}{8}$
2	$\frac{3}{4}$	$3\frac{1}{8}$	$\frac{3}{8}$
3	$\frac{3}{4}$	$3\frac{1}{2}$	$\frac{3}{8}$
4	$\frac{3}{4}$	4	$\frac{3}{8}$
5	$\frac{7}{8}$	$4\frac{3}{8}$	$\frac{3}{8}$
6	1	$4\frac{3}{8}$	$\frac{3}{8}$
7	1	5	$\frac{3}{8}$
8	$1\frac{1}{4}$	$5\frac{1}{2}$	$\frac{3}{8}$

No.	Length Over All	Large End Ball	Small End Ball	
2	$4\frac{1}{2}$	$1\frac{3}{8}$	$\frac{7}{8}$	Large ball can be drilled and faced any size desired.
4	$5\frac{1}{2}$	$1\frac{3}{8}$	1	
6	$6\frac{1}{2}$	$1\frac{3}{8}$	1	
8	$7\frac{1}{2}$	$1\frac{3}{8}$	1	
10	$8\frac{1}{2}$	$1\frac{3}{8}$	$1\frac{1}{8}$	
11	9	$1\frac{3}{8}$	$1\frac{1}{8}$	

TWO BALL LEVERS

Adapted for Tail Stock, Tighteners, Drill Press Clamps,
Back Gear Levers, and for all similar
purposes.



Manufactured as a specialty and sold below the manufacturing cost of cast iron or forged handles. Estimates given on large screw machine work, handles and screws of every description.

NORTON COMPANY

WORCESTER, MASS., U. S. A.

NEW YORK STORE
151 Chambers St.

CHICAGO STORE
11 N. Jefferson St.

Electric Furnace Plants
NIAGARA FALLS, N. Y.—CHIPPAWA, CAN.

Manufacturing Plants
WORCESTER, MASS.—WESSELING, GERMANY

ALUNDUM AND CRYSTOLON GRINDING WHEELS, ALUNDUM AND CRYSTOLON GRAIN FOR POLISHING, ALUNDUM REFRACTORIES AND LABORATORY WARE, GLASS CUTTING WHEELS, INDIA OIL STONES AND CRYSTOLON SHARPENING STONES, RAZOR HONES, SCYTHE STONES, VALVE GRINDING COMPOUND, RUBBING BRICKS AND STONES, GRINDING WHEEL DRESSERS, GRINDING MACHINERY

ALUNDUM (Al_2O_3) is made from Bauxite by fusion in an electric arc furnace. Its hardness, sharpness and toughness—"temper"—are under control. This in combination with its characteristic conchoidal fracture, makes Alundum grinding wheels peculiarly effective upon materials of high tensile strength—notably steel and its alloys.

CRYSTOLON is Silicon Carbide (SiC) in crystalline formation. By the use of the purest materials and a scientifically correct process, an abrasive material of wonderful purity and remarkable cutting qualities is obtained. Its characteristic property of brittleness makes it highly efficient upon cast iron, brass, marble and other materials of low tensile strength.

The majority of Norton Grinding Wheels are made by the Vitriified process, in which the materials constituting the formulæ are mixed in power mixing kettles. Most Norton Wheels over 30" diameter are made by the Silicate process, the bond and grain being mixed by special machinery.

Elastic wheels are made in molds and baked at low temperature. They possess a high degree of safety, making them particularly valuable for operations requiring thin wheels. We make them as thin as $\frac{3}{16}$ " up to 4" diameter, $\frac{1}{8}$ " thick up to 8" diameter and $\frac{1}{4}$ " thick up to 12" diameter. Used to great extent for saw gumming, grinding between teeth of gears, wood working tools, etc. Also especially adapted for roll grinding.

Wheels larger than 5" diameter are tested at 9000 surface feet per minute. As the usual working speeds are from 5000 to 6000 feet, these tests insure a high factor of safety.

REFRACTORIES—Until the invention of the process for making Alundum, Bauxite was considered infusible. This well-known property has made Alundum especially valuable as a refractory material. Alundum is made into Electric Furnace Cores, Tubes and Muffles; Crucibles, Combustion Boats, Filtering Crucibles and Cones, Extraction Thimbles and Refractory Cements.

Any of these Booklets will be sent on request

Alundum
Catalog of Grinding Wheels
Alundum-Crystolon Grinding Wheels
Alundum Grain for Polishing

Norton Refractories—Alundum and Crystolon
Helps—Don'ts for All Who Grind
Grinding Wheels for the Saw Mill
Norton Valve Grinding Compound
Alundum and Crystolon in the Glass Industry

SPECIAL RESEARCH SERVICE—We have well-equipped research laboratories with a competent staff of research workers and demonstrators who are always ready to give you the benefit of their special knowledge and wide experience in the solving of your special problems.

Alundum



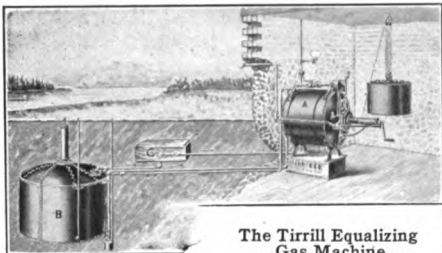
Crystolon

TIRRILL GAS MACHINE LIGHTING CO.

Established 1884

103 PARK AVE., NEW YORK

MANUFACTURERS OF TIRRILL GAS MACHINES, FUEL GAS PLANTS, GAS BURNERS AND GAS APPLIANCES, PNEUMATIC WATER SUPPLY OUTFITS, STORAGE TANKS, ETC.



The TIRRILL Equalizing Gas Machine

THE TIRRILL "EQUALIZING" GAS MACHINE

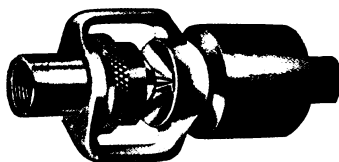
Furnishes gas for lighting, heating, power and fuel purposes. Used extensively for Sterilizers, Autoclaves, Blast Furnaces, Forges and Gas Appliances of all kinds.

Consists of (A) Air Pump, (B) Generator and (C) Mixer and is guaranteed to deliver a white, or blue, absolutely smokeless flame

without odor. Absolutely safe. Has approval of Underwriters.

TIRRILL GAS BURNERS AND GAS APPLIANCES

The very best results are only obtained when using gas for fuel by adopting the proper burner and appliances for the work to be accomplished. Our experience of over half a century has made us *specialists in this line* and we are prepared to make special Burners for all kinds of gas and for every purpose.



Tirrill Combination Mixing Valve

The TIRRILL IMPROVED COMBINATION REGULATOR is carefully constructed

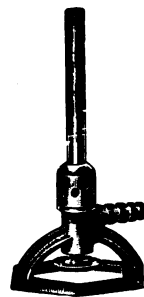
on scientific and practical lines. Absolutely controls both the quality and the pressure of the gas, and regulates them with one adjustment. As a Mixing Valve for ovens, stills, sterilizers, autoclaves and gas fuel heating appliances for all purposes it is **GUARANTEED** to produce perfect combustion at the burner, with *minimum of gas consumption*.



Tirrill High Efficiency Heating Burner No. 2002



Tirrill High Efficiency Heating Burner



Tirrill Improved Bunsen Burner No. 2600

Our High Efficiency Heating Burners are furnished in any style. Maximum heat distribution is always obtained as our long experience in this line enables us to correctly design the spacing and size of the gas outlets.

FUEL GAS PLANTS FOR INDUSTRIAL USES

Soldering and brazing, singeing and heating irons, various uses in silk factories, heating ovens, vulcanizing, for calendars, and numerous other mechanical purposes.

The Tirrill Gas Machine Lighting Co. contract to erect Fuel Gas Plants for any of the above named purposes and will be glad to submit estimates for this kind of work.

We are specialists in High Efficiency Gas Appliances for Every Purpose, both Domestic and Industrial.

GILBERT & BARKER MFG. CO.

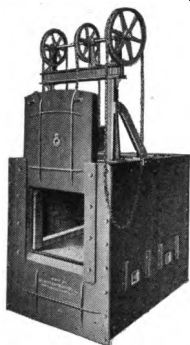
Established 1865

SPRINGFIELD, MASS.

NEW YORK, 26 Broadway

DESIGNERS AND MANUFACTURERS OF FUEL-OIL BURNING APPLIANCES, FUEL-GAS MACHINERY, FURNACES, ETC.

Fifty years practical experience, combined with a thorough knowledge of fuels and combustion enters into the designing and building of Gilbert & Barker Furnaces. Our furnaces are convenient for the operator, from whom they require little attention—giving a reliable and uniform heat throughout—and burning the fuel in the smallest possible space with complete combustion—they economize in time, labor, up-keep and fuel.



Semi-Muffle Heat Treating Furnace

SEMI-MUFFLE FURNACES

For Case Hardening, Annealing, Carbonizing, Heat Treating, General Hardening and Heating Work.

(Oil or Gas Fuel.)

The Gilbert & Barker Semi-muffle furnaces are designed for and accomplish the most exacting work. Complete combustion of the fuel takes place beneath the floor of the heating chamber. The hot gases then pass to the heating chamber through suitable opening so placed that the heat is evenly distributed without a variation of one degree, and the perfect regulation of the flame makes oxidation and overheating impossible. Provision is made for a pyrometer by which the exact degree of heat can be accurately measured. No flue or chimney is required with this type of furnace.

GAS FURNACES

Our line includes End-Heating Furnaces, Forging and Welding Furnaces, Semi-Muffle Furnaces, Muffle Furnaces, Round, Rectangular and Double Pot Furnaces for hardening with lead and cyanide, Round and Rectangular Pot Furnaces for tempering and bluing, Crucible Furnaces, Bench Forges, and Soldering Furnaces.

BURNING FUEL OIL UNDER LOW PRESSURE

Under the Gilbert & Barker Process, oil is burned with a clean, clear fire, and with complete combustion. For hardening, tempering, case hardening, melting, annealing, heating, singeing plates, and all sorts of work requiring a clean, even heat, oil has proved an economical fuel.

The apparatus consists of a specially constructed rotary air compressor, an oil pump, a storage tank, the burners and necessary piping. The oil is brought to the furnace under pressure and enters the furnace in the form of a spray. By our method of applying the burners to a furnace, free air is drawn in around the burner sufficient for complete combustion.



Rectangular Pot Furnace

We shall be pleased to furnish complete information on the equipment of complete heat treating departments from storage tank to burner, and furnaces.

THE DAVIDSON STEEL CO., INC.

MAIN OFFICE: 124 MAIDEN LANE, NEW YORK

MILLS: SHEFFIELD AND BIRMINGHAM, ENGLAND & U. S. A.

ALL GRADES OF ALLOY STEEL FOR ALL PURPOSES

"HEHTEMND"

After years of experimenting we have produced this Chrome Nickel Vanadium steel.

It is the toughest and strongest steel made for automobile gears, pinions, axles, etc.

We guarantee this steel will machine at 100 to 170 ft. per minute with ordinary high speed steel.

It is as non-changeable as the best oil hardening die steels.

You cannot break it.

You may finally tear it.

Greater tensile strength and more non-crystallizing than Chrome Vanadium.

Greater Elasticity than nickel or chrome nickel.

Easier Machining qualities than machine steel.

Physical Qualities

(Approx.)

	Annealed	Treated
Tensile Strength.....	120,000	205,000
Elastic Limit.....	98,000	170,000
Elongation.....	25%	20%
Reduction of Area.....	50%	45%
Sclerescopic Reading.....	25 soft annealed, 83 hard treated	

"THREE HUNDRED" SPRING STEEL

Has greatest resistance against crystallization and climatic changes. Requires no expert treating.

We are Specialists

Large stocks on hand at our New York warehouses.

ELLSWORTH HARING

114-118 LIBERTY ST., NEW YORK

HIGH SPEED, COLD ROLLED, CRUCIBLE AND ALLOY STEEL. NICKEL—PURE, IN RODS, BARS, SHEETS AND WIRES. RESISTANCE WIRES, VARIOUS GRADES.

You no doubt will have use for some of the metals and specialties listed below; look over the list and send a trial order.

Regular High Speed Steel for general Shop tools.

Special High Speed Steel for Cutters, Drills and Tools. One step better than regular.

Double X Highest Grade High Speed Steel. Vanadium Tungsten Alloy Steel. Nothing better on the market—made for the most powerful machines built, will cut where other steels of its kind will not stand.

Tool Holder Bits in 5 and 10 lb. Boxes.

Tool Steels. Carbon and Alloy Steels for all purposes. Including non-shrinkable Steels for Dies. Oil and water hardening.

Nickel Steels. 25 to 30%, also 1½% and 3½% Nickel Steels.

Drill Rods and Drawn Steel for Tools, Punches, etc., High Grade drawn from Imported Rods. Hardware and Medium Grades. Drawn Steel for Needle Bars, Scale Bar Rails, Carriage Steel for Typewriters, etc. Drawn Steel for Ball Manufacturers, etc.

High Speed Steel Drill Rods.

Chrome Steel for Ball Races.

Composite Steel (English Manufacture). Half Iron and Steel Composite.

Hack Saw Sheets (English Manufacture).

Automobile Steel. Various Grades of Alloy Steels for Water, Air, Oil and Case Hardening—for all purposes.

Special Steel. Saw Steel, Plow Steel, Alloy Steel, Spring Steel, Shovel Steel, Crucible and O. H. Plates, Sheets, Bands.

Cold Rolled Strip Steel. High Carbon. Excellent finish. Dead soft annealed and medium hard—to take temper—can also supply this steel for various purposes in various grades.

Cold Rolled, Tempered and Polished Steels.

Magnet Steel. Various qualities.

Transformer Silicon Steel.

Forgings.

Welding Wires. Special Iron Wire for Electric Welding, etc.

E-H Ignition Metal. Coils-Rods and sheets for Spark Points and Ignition Devices. *Send for special list.*

Nickel Rolled Anodes. For Electro Plating.

Nickel Cast Anodes. For Electro Plating.

Nickel Sheets. For Field Kitchens, etc.

Permanent Magnets. Send blue print and specifications for prices.

Ignition Points. Finished points made to order.

Balls. Brass and Bronze Balls.

Steel Balls. Highest grades absolutely accurate. Medium grade—Hardware grade.

Music Wire. For Springs, Brick Cutters, etc.

Machine Needle & Sewing Machine Wire. Highest Quality.

Mixer Knives. For Cutting Pulp, etc. (a specialty).



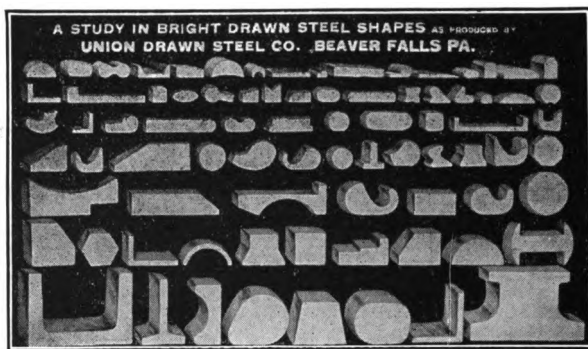
UNION DRAWN STEEL COMPANY

Works and General Office
BEAVER FALLS, PA.

WAREHOUSES: NEW YORK, PHILADELPHIA, CHICAGO, CINCINNATI, DETROIT.

BRANCH SALES OFFICES: BOSTON, BUFFALO, ATLANTA.

MANUFACTURER OF BRIGHT FINISHED STEEL EXCLUSIVELY IN ROUNDS, SQUARES, HEXAGONS, FLATS AND SHAPES, SHAFTING, SCREW STEEL, AXLE STEEL, BESSEMER, OPEN HEARTH, CRUCIBLE, NICKEL AND VANADIUMS, DRAWN—COLD ROLLED AND TURNED STEEL.



214

SPECIAL SHAPES OF COLD DRAWN STEEL of any dimensions within our range and for all purposes, will be made in the shortest possible time consistent with perfection in quality, in accordance with specifications furnished, where sufficient quantity will justify equipment.

The most comprehensive stock of Bright and Finished Steel, Rounds, Squares, Hexagons and Flats carried at our Branch warehouses, in addition to the large stock we carry at our mill.

We are the largest manufacturers of cold finished steel and iron for shafting and various machinery uses. Established 1889, but rebuilt Fireproof Plant and all new machinery installed, 1911.

SHAFTING.—We use only the best quality of soft steel and are manufacturing under recent patents, covering machinery and appliances, by a process superior to anything known for producing work mathematically accurate as to size, absolute straightness, and a perfectly polished surface.

PISTON AND PUMP RODS.—For piston and pump rods we use a special grade of steel, and can produce them strictly uniform in size and quality, highly polished, perfectly straight, and of lengths up to 60 or 70 feet.

SCREW STEEL.—For this work we furnish a special analysis of steel, which, after years of experiment, has proved best adapted to free cutting and threading, and for the production of the maximum number of parts in the minimum of time, by the use of automatic and hand screw machines and Turret lathes.

SPECIAL STEEL.—For the various places where special grades of steel are required, our experience and facilities are such that we can promptly furnish material best adapted for the special requirements.

ELEVATOR GUIDES.—We make Cold Drawn Steel Elevator Guides. Perfectly matched joints. Perfectly straight.

ALLOY STEELS.—Cold Drawn Nickel, Chrome Nickel, Vanadium, Chromium and Electric Furnace Alloy Steels. Heat treated or unheat treated, for Automobile and Machinery use.



ALUMINUM COMPANY OF AMERICA

PITTSBURGH, PA.

BRANCH OFFICES

NEW YORK, 99 John Street	ROCHESTER, N. Y., 1112 Granite Bldg.
BOSTON, MASS., 131 State Street	PHILADELPHIA, PA., 1315 Pennsylvania Building
PITTSBURGH, PA., 2420 Oliver Bldg.	KANSAS CITY, MO., 308 R. A. Long Bldg.
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CHICAGO, ILL., 1500 Westminster Bldg.	DETROIT, MICH., 1512 Ford Bldg.
TORONTO, ONT., NORTHERN ALUMINUM CO., LTD., 1503 Traders Bank Bldg.	
PIERSON, ROEDING & COMPANY, 118 New Montgomery St., SAN FRANCISCO, CAL.	

ALUMINUM

INGOT, CASTING ALLOYS, SHEET, FOIL, ROD, WIRE, TUBING, MOULDINGS, FITTINGS, ELECTRICAL CONDUCTORS, BRONZE POWDER AND LITHOGRAPH PLATES

FABRICATED ALUMINUM

Steam jacketed kettles, tanks of all sizes and descriptions, pans, coils, pipe lines and miscellaneous apparatus for chemical, fruit juice and other manufacturers.

ELECTRICAL CONDUCTORS

The use of Aluminum for electrical conductors has continually increased during the past five or six years. Its properties make its use desirable in electrical construction and it is now being successfully used for High Tension Transmission Wire, Railway Feeders, Bus-Bars, etc.

PUBLICATIONS

The following publications issued by us contain much valuable information for the aluminum user and will be gladly sent to those interested:

PROPERTIES OF ALUMINUM
ALLOYS OF ALUMINUM
METHODS OF WORKING ALUMINUM
FABRICATED ALUMINUM
ALUMINUM FOR ELECTRICAL CONDUCTORS
INSTRUCTIONS FOR INSTALLATION AND MAINTENANCE OF ALUMINUM ELECTRICAL CONDUCTORS
ALUMINUM—ITS USE IN THE BREWERY
STEAM JACKETED KETTLES
USEFUL TABLES



THE AMERICAN BRASS COMPANY

WATERBURY, CONNECTICUT, U. S. A.

MILLS AND FACTORIES:

ANSONIA BRASS AND COPPER BRANCH, ANSONIA, CONN.
BENEDICT AND BURNHAM BRANCH, WATERBURY, CONN.
COE BRASS BRANCH, - - - - TORRINGTON, CONN.
COE BRASS BRANCH, - - - - ANSONIA, CONN.
KENOSHA BRANCH, - - - - KENOSHA, WIS.
WATERBURY BRASS BRANCH, - - WATERBURY, CONN.

BRASS, COPPER AND GERMAN SILVER

IN EVERY VARIETY OF SHEETS, ROLLS, PLATES, WIRE AND RODS, MOULDINGS,
ANGLES AND CHANNELS, CIRCLES, BLANKS AND SHELLS

SEAMLESS AND BRAZED TUBING

CONDENSER TUBES AND LOCOMOTIVE TUBES

TOBIN BRONZE AND PHOSPHOR BRONZE

RODS, PLATES AND SEAMLESS TUBING

EXTRUDED METAL

RODS, SPECIAL SHAPES AND PRESSED METAL PARTS

TURBINE BLADING AND CALKING STRIPS

OF BRASS OR CUPRO NICKEL

BENEDICT NICKEL WHITE METAL

SEAMLESS TUBING, SHEETS, WIRE, RODS AND INGOT

BARE AND INSULATED COPPER WIRE AND CABLES

"K. K." WEATHERPROOF AND SLOW BURNING WIRE, ROUND AND FLAT
MAGNET WIRE

BRIDGEPORT BRASS COMPANY

BRIDGEPORT, CONNECTICUT

**SEAMLESS DRAWN BRASS AND COPPER TUBING FOR ALL PURPOSES;
ALSO CONDENSER TUBES—BRASS AND ADMIRALTY MIXTURE,
TINNED AND PLAIN; FERRULES OF ALL KINDS**



SEAMLESS DRAWN BRASS AND COPPER TUBING

Our tubing is made from the ingot to the finished tube in our own mills, and in its manufacture the metal is worked and treated in such a way that a close grained, uniformly strong and tough wall is insured. *"Bridgeport" Seamless Tubing is guaranteed tubing of the highest quality.*



Every "Bridgeport" tube is rigidly tested to withstand 1000 lbs. (internal) water pressure

The severity of the requirements in modern power station service demands the highest grade of Condenser Tubes—for Condenser Tubes of quality, specify "Bridgeport."

BRONZE IN SHEET AND ROD. "Bridgeport" Bronze has great tensile strength, and high elastic limit, is used for shafting, piston or plunger work. We are also manufacturers of Aluminum, Phosphor and Silicon Bronze.

SPECIAL SHAPES drawn or stamped from Brass, Copper, Bronze and German Silver. We make the articles from ingot to finished part. Send sample or blue-print for estimates.

THE BAYONNE CASTING COMPANY

GENERAL OFFICES AND WORKS, BAYONNE, N. J.

MONEL METAL; BRASS, BRONZE, ALLOYS

MONEL METAL

Monel Metal contains approximately 67% nickel, 27% copper and 6% of other metals, principally iron and manganese; and with its high tensile strength and its non-corrosive properties greatly excels the best Manganese, Tobin or Phosphor Bronze.

Cast Monel Metal has a tensile strength of 70,000 lbs. per square inch, while the rolled metal is much stronger, having a tensile strength of 80,000 to 100,000 lbs. per square inch.

In appearance, Monel Metal cannot be distinguished from pure nickel and takes the same finish. Its great strength, together with its extreme incorrodibility, admirably adapt it for use in marine work and engineering construction, for parts that come in contact with salt water and for valves and fittings that are subject to superheated steam.

Monel Metal can be furnished in any of the following forms: CASTINGS, RODS AND BARS, WIRE, FORGINGS, BOLTS AND NUTS.

MONEL METAL CASTINGS



CASTINGS: The greatest tonnage of Monel Metal Castings made up to the present time has gone into propellers for the U. S. Navy and private yachts. The Navy has also purchased castings for pump linings, steam turbine nozzles and valve fittings for superheated steam. Many castings have been made for use in dairy machinery, refrigerating plants, and pickling apparatus in steel mills. Various other castings that have been made are thermometer wells, gear blanks, large washers and nuts, deck fittings for yachts, pump parts, radiator castings, etc.

RODS: Hot rolled Monel Metal rods up to 6" diameter have been furnished principally for pump rods. Small sizes of rounds and squares are extensively used for bolt and nut stock. Rolled rods are now used for steam turbine parts, stock for drop forgings, electrical apparatus, motor boat shafting, pickle pins and valve stems.

WIRE: Monel Metal wire can be furnished in all gauges from B & S No. $\frac{1}{4}$ " up to No. 40. It is used for wire cloth, motor cycle spokes, rope for wire hoists and cableways, nails, screws, rivets, etc., and innumerable other applications where high tensile strength, combined with non-corrosive features are essential.

FORGINGS: Monel Metal forgings show tensile tests, equivalent to steel. The importance thereof can be readily appreciated for parts of gas, oil or internal combustion engines of all types; automobile and motor boat fittings; steam turbine fittings and innumerable applications requiring a metal that will stand up under the most severe conditions.

The Bayonne Casting Company can make castings of Monel Metal from customers' patterns, of any size or description up to 25,000 lbs. in weight in one piece. The plant has been equipped to produce such castings as promptly and at as low a cost as is compatible with first-class workmanship. They will be pleased to furnish hot rolled rods at the lowest prices. Monel Metal can be obtained in the form of ribbon, round and flat wire, although this is not carried in stock because of the great variations in sizes required. Prices of forgings, bolts and nuts of the various types and sizes will be promptly quoted on request.

DOEHLER DIE-CASTING CO.

COURT & NINTH STS., BROOKLYN, N. Y.

WESTERN PLANT: E. Woodruff and N. 12th Sts., TOLEDO, OHIO

**MANUFACTURERS OF ALUMINUM AND WHITE METAL DIE-CASTINGS
AND BABBITT LINED BRONZE BEARINGS****DIE-CASTINGS**

The accompanying cuts are photographic reproductions showing the sharp outlines and smooth finish of our castings. These die-castings are made in steel dies by our patented process, and represent the modern economical way of producing finished parts rather than by machining.

Parts heretofore considered machine impossibilities become, by our process, realities. Inventions shelved as impractical or too costly to produce become money makers.

Cheaper production on intricate parts is not the only saving afforded by this process. Die-cast parts are exactly alike, and absolutely accurate, so that time gained in the assembling room is an important factor.

It is a foregone conclusion, considering the expense of a steel-die, that parts wanted in small quantities usually are not die-casting propositions. Cast-iron parts with little machining do not prove any saving, the handicap on the cost of material is too great to overcome to make an attractive showing.

Generally speaking, intricate parts made in brass and used in large quantities yield the greatest saving. However, circumstances and individual cases differ so much that no general rule can be outlined and, therefore, we gladly give our advice on any part at any time, or enter into correspondence on all subjects relating to die-casting with parties interested or seeking information.

The following is a brief attempt to give the main characteristics of our different alloys and their usefulness.

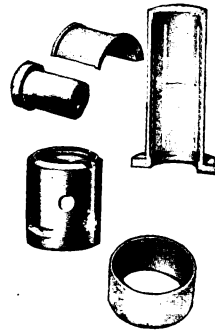
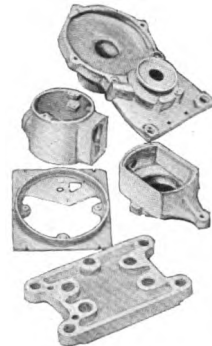
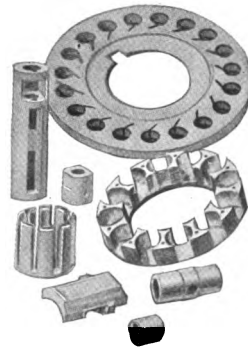
No. 3 Metal. Zinc, alloy hard, good bearing metal, compares favorably with cast iron. Can be plated any color.

No. 47 Metal. Tin alloy. Good bearing metal, medium priced. Toughness of soft brass. Non-corrosive.

No. 28 Metal. Tin alloy. Genuine babbitt found after many years of actual service to be best suited for light gas engine work.

No. 51 Metal. Lead alloy: acid proof metal. Used for machine parts where a non-corrosive metal is required and where working strain is low.

No. 12 Metal. Aluminum alloy: consisting of aluminum and copper. High tensile strength, tough and durable. Takes and holds high polish. This alloy conforms with the Aluminum Company's standard No. 12 alloy.

**Die-Cast Babbitt Bearings and Bushings.****Automobile Accessories.****Ball and Roller Bearing Retainers.**

LUMEN BEARING COMPANY

BUFFALO

BRASS FOUNDERS

Lumen Bronze

20% lighter than a phosphor bronze of the same bearing capacity—and 30% less expensive on a high metal market.

	Sand Cast	Chill Cast
Tensile Strength	32-36000	40-45000
Elongation	0%	0%
Brinell Hardness	114-119	119-124
Specific Gravity	6.9	
Weight per cubic inch	0.25	
Shrinkage	$\frac{3}{8}$ "	
Compressive Strength	60000	

L. B. Manganese Bronze

	Sand Cast	Chill Cast
Tensile Strength	72-84000	80-88000
Elongation	22%-35%	26%-32%
Brinell Hardness	109-119	124-130
Specific Gravity	8.4	
Weight per cubic inch	0.30	
Shrinkage	$\frac{1}{4}$ "	

Gear Bronze

	Sand Cast	Chill Cast
Tensile Strength	31-35000	48-52000
Elongation	6%-10%	8%-12%
Brinell Hardness	72-77	100-105
Specific Gravity	8.5	
Weight per cubic inch	0.307	
Shrinkage	$\frac{1}{8}$ "	

We issue pamphlets from time to time containing specific data about non-ferrous castings, and will gladly put your name on our mailing list, if so requested.

Phosphor Bearing Bronze

	Sand Cast	Chill Cast
Tensile Strength	28-30000	40-42000
Elongation	5%-7%	3%-5%
Brinell Hardness	65-70	86-89
Specific Gravity	9.0	
Weight per cubic inch	0.33	
Shrinkage	$\frac{1}{8}$ "	

Special Bronzes

We are prepared to meet any commercial specifications and to produce in our castings the highest physical qualities consistent with any chemical formula. We maintain a fully equipped laboratory for the purpose of controlling our alloys. We have all facilities and tools, including a 50000 pound testing machine.

To Engineers

We invite you to visit our plant at any time. Telephone Oxford 77—address 197 Lathrop St.

AMERICAN VULCANIZED FIBRE CO.

ESTABLISHED 1873

WILMINGTON, DELAWARE

VULCANIZED FIBRE

Manufacture—In the manufacture of fibre there are three factors absolutely essential to mechanical strength and electrical insulation: 1. Pure Raw Material. 2. Experience and care in the process of making. 3. Freedom from chemicals in the finished product.

American Vulcanized Fibre is made from raw stock free from iron, bone or other impurities.

The processes of manufacture are accurately and scientifically controlled.

The finished product undergoes rigid chemical analysis and physical test.

As the sole makers of *Original* Vulcanized Fibre, we naturally know how to make the very finest fibre and constant endeavor produces a better and more uniformly excellent product each year.

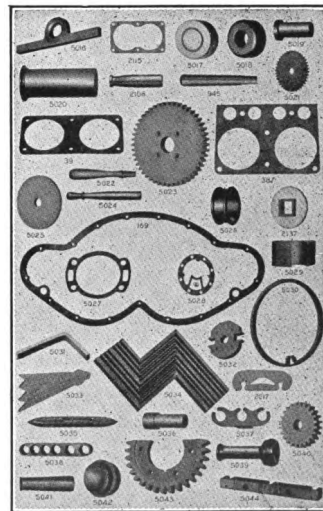
The result is a tough, homogeneous, horn-like material with the following valuable characteristics:—

Characteristics: Tensile strength 9,000–14,000 lbs. per sq. in., Compressive strength 32,000–37,000 lbs. per sq. in., Resistance to shearing 9,000–13,000, Specific Gravity 1.2–1.5, Electrical Rupture 200–400 volts per 1/1000 inch of thickness.

COMPARATIVE TABLE	Pounds per cu. ft.	Effect of Oil, etc.	Effect Rodents, Vermín, etc.	Brittle or Tough	Effect of Age
VULCANIZED FIBRE...	85	None	None	Tough	Improves
Porcelain, etc.	144	None	None	Brittle	...
Hard Rubber.	150	Deteriorates	....	Brittle	Deteriorates
Rawhide, Leather, etc....	Varies	Deteriorates	Destroy	Tough	Deteriorates

Partial List of Applications

Adjusters (Cord)	Mirror Backs
Baskets (Hop)	Packings
Baskets (Mill)	Pinions (Noiseless)
Baskets (Waste)	Rings
Bases (Switch)	Rods
Bearings (Plain,	Rollers
Thrust, etc.)	Rolls (Pinking)
Robbins (Coil)	Seats (Chair)
Boxes	Shims (Switch)
Bumpers (Textile)	Shoe Horns
Bushings	Shoes (Brake)
Cans (Roving)	Staples (Insulating Saddle)
Checks (Factory Time)	Straps (Brake)
Cleats	Switch Bars
Conduits (Interior)	Tacks (Insulated Wiring)
Discs (all kinds)	Tags
Ferrules (Condenser,	Telephone Cleats
Handle)	Tie Plates (Railroad)
Frames (Bolster Case)	Trucks (Mill)
Frictions	Tubes
Gaskets (Oilproof)	Valves (Pumps)
Gears (Noiseless)	Washers, (Friction, Thrust,
Gear Blanks	Insulating, Compression,
Gibs (Engine, Crossheads)	Cock, Pipe Union, Car-
Handles	riage Axle, Car Box)
Heads (Magnet, Bobbin,	Wedges (Armature)
Spool)	Wheels
Insulation	Wiring Cleats
Insulators (Rail Joint)	And many others.
Linings (Clutch) "Auto"	



A moment's thought will undoubtedly suggest to you applications not named above which will improve or cheapen your product or facilitate its manufacture.

Our Development Department is at your service to solve your problems, answer your inquiries or quote you prices, without obligating you in the slightest.



THE CLARK CAST STEEL CEMENT CO.

SHELTON, CONN., U. S. A.

SOLE MANUFACTURERS OF CAST STEEL CEMENT

CAST STEEL CEMENT

For Perfecting Iron and Steel Castings

During the past twenty years Cast Steel Cement has earned a place in every first class foundry, has saved thousands of dollars' worth of castings which would otherwise have been thrown away because of blow-holes, shrinkage holes, cracks or other surface defects sufficient to condemn a casting for its appearance, its utility being otherwise unquestioned.



Condition

NEITHER A PUTTY, A PAINT, NOR A MERE FILLER



Remedy

Cast Steel Cement is neither a putty, a paint, nor a filler; but is actually metallic iron in such chemical combination that it will, when slightly moistened and thoroughly worked, permit of being used like modeling clay to fill out any form or fill up any defect in a casting

It will adhere permanently to the real casting, become a part of it, and will never crumble or fall out, turn yellow or white, nor fine crack from brittleness. It sets quickly and permanently, with the appearance and hardness of the casting itself, and continues to harden for months afterward.

REDUCE YOUR PERCENTAGE OF REJECTED CASTINGS

By the use of Cast Steel Cement—the only permanent filler for Iron and Steel Castings—you can save more than a foreman's salary. The cost of saving a hundred dollars' worth of castings is only a few cents.



Result

Cast Steel Cement is particularly adapted to Iron and Steel Castings, but is also unequalled for making permanent tight joints in heaters, furnaces, and steam, gas, air and water pipes, calking boilers, etc.

We are always glad to help foundrymen increase their dividends—are we helping you? If not, why not let us prove at our own expense that we can do this? **FREE SAMPLES**

THE CHAMPION RIVET CO.

Established 1895

CLEVELAND, OHIO

MANUFACTURERS OF BOILER, SHIP, STRUCTURAL AND TANK RIVETS

VICTOR STEEL RIVETS

The Champion Rivet Company invites the closest inspection of the quality of Open Hearth Steel used in the manufacture of Victor Rivets, and we have given in our catalog fac-simile of chemists' reports and tests from laboratories of the highest standing.

Open Hearth Steel fulfills every requirement for a rivet steel. This is amply proved by the use of Victor Rivets in the most important works, and by the numerous tests which we offer in our catalog.

ACTUAL RESULTS OF TESTS

Showing the Physical Qualities of Victor Steel Rivets

Sample Mark	Diam. of Bar in inches	Elastic Limit in pounds per square in.	Ultimate Tens. Strength pounds per sq. in.	Elongation in 8 ins. per cent	Reduction of Area per cent	Character of Fracture
Steel Rivet Bar No. 1..	1.100	38210	49840	35.	61.7	Silky
" " " " 2..	1.100	37650	50880	35.	62.3	"
" " " " 3..	.895	32430	46735	31.2	62.9	"
" " " " 4..	.985	33532	54320	33.7	66.5	"
" " " " 5..	.735	37720	55070	33.7	66.5	"
" " " " 6..	.605	43150	53540	29.5	66.6	"
" " " " 7..	.480	40630	50030	32.5	62.2	"
" " " " 8..	.675	34090	51710	28.	64.9	"
" " " " 9..	.670	33760	53190	30.7	72.7	"
" " " " 10..	.855	31350	50340	30.	67.1	"
Steel Rivet No. 1.....	.855	33710	55380	65.8	"
" " " " 2.....	.855	35220	55300	67.8	"

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Standard Heads of Large Rivets

Standard Heads for Small Rivets made in Cone, Button, Tank Pan, Flat Countersunk, Oval Countersunk, Flat and Wagon Box types. We are now making Sheet Iron Rivets of this type smaller than $\frac{1}{2}$ " diameter. We are also prepared to make these small rivets with special heads of all kinds.

Standard Heads of Large Rivets made in Cone, Button, Steeple, Flat Countersunk, Pan Head Swell Neck, Pan Head Straight Neck, Oval Countersunk, Flat Head types. Special types, heads, etc., can be made to meet the requirements or ideas of any consumer as might be outlined.

Victor Boiler Rivets conform strictly to the Standard Specifications for Boiler Rivet Steel adopted by the American Society for Testing Materials, both as regard physical and chemical tests.

The fourth edition of our book, "Scientific Facts and other Valuable Information Relative to Victor Boiler, Structural Ship and Tank Rivets," contains more valuable, scientific and original information than has been published in book form—yours for the asking.

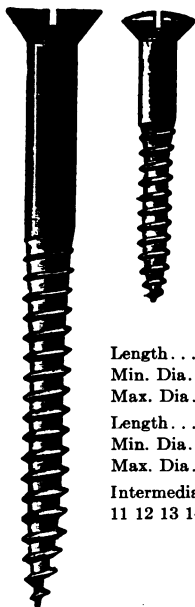


AMERICAN SCREW COMPANY

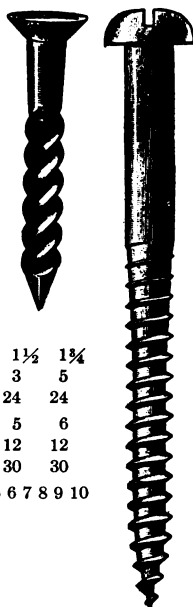
PROVIDENCE, R. I.

MAKERS OF WOOD SCREWS, MACHINE SCREWS, STOVE BOLTS,
TIRE BOLTS, RIVETS, ETC.

Flat Head Oval Head



Drive Screw Round Head



WOOD SCREWS

Flat and Round Head Wood Screws are regularly made in Iron in the following sizes, and in Brass in sizes of approximately the same variety; other kinds of Wood Screws are made in the sizes commonly used.

Length.....	¼	⅜	½	⅝	¾	⅞	1	1¼	1½	1¾
Min. Dia.....	0	0	1	1	2	2	3	3	3	5
Max. Dia....	4	9	12	14	16	16	20	24	24	24
Length.....	2	2½	2½	2¾	3	3½	4	4¼	5	6
Min. Dia.....	5	5	5	6	6	8	8	12	12	12
Max. Dia....	24	24	24	24	26	26	30	30	30	30

Intermediate diameters advance as follows: No. 0 1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 20 22 24 26 28 30

MACHINE SCREWS

Flat, Round, and Fillister Head Machine Screws are regularly made in Iron in the following sizes, and in Brass in sizes of approximately the same variety:

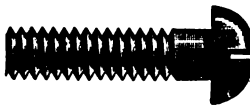
Length.....	⅜	½	⅝	¾	⅞	1	1¼	1½	1¾	1½	1¾	1½	1¾
Min. Dia....	2	2	2	2	2	2	2	2	2	4	4	4	4
Max. Dia....	10	14	16	24	24	24	24	24	34	34	34	34	34
Length.....	1¼	2	2¼	2½	2¾	3	3¼	3½	3¾	4			
Min. Dia....	4	4	5	7	7	7	9	9	4	4			
Max. Dia....	34	34	34	34	30	30	30	30	30	30			

Intermediate diameters advance as follows: No. 2 3 4 5 6 7 8 9 10 12 14 16 18 20 24 30 34

Flat Head



Round Head



Fillister Head



Diameter No.	2	3	4.5	6	7	8	9.10	12	14
Threads per in.	48.56.64	48.56	32.36.40	30.32.36	30.32	30.32.36	24.30.32	20.24	18.20.24
	16.18	20	24	30	34				
	16.18.20	16.18	14.16.18	14.16	13				

Regular Side Knob Screws  are ⅝ inch No. 9, 24 thread.

AMERICAN SCREW COMPANY

STOVE BOLTS



Flat and Round Head Iron Stove Bolts are regularly made in the following sizes:

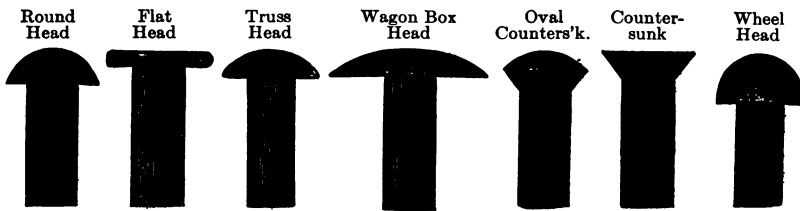
Diameter.....	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{3}{4}$
Min. Length.....	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{4}$	1
Max. Length.....	2	2	$6\frac{1}{2}$	$6\frac{1}{2}$	$6\frac{1}{2}$	$6\frac{1}{4}$	$6\frac{1}{2}$	3

The length advances by eighths of an inch from $\frac{3}{8}$ to $1\frac{1}{2}$, then by quarters to $6\frac{1}{2}$.

STOVE RODS

Stove Rods are the same as Stove Bolts in every respect excepting length. They are regularly made in Iron of $\frac{3}{16}$ and $\frac{1}{4}$ diameter in length from 7 to 40", advancing by halves of an inch.

RIVETS



Cold-headed Rivets are made in great variety of styles and sizes up to $\frac{1}{8}$ in. diameter and 6 in. length.

MEASUREMENTS

The length includes the head of Flat Head Screws, Stove Bolts, and Stove Rods; excludes the head of Round and Fillister Head Machine Screws and Round Head Stove Bolts and Stove Rods; includes the countersink of Oval Head Screws and about half the head of Round Head Wood Screws, but the practice with regard to Round Head Wood Screws is not uniform with all makers.

The length of Rivets is exclusive of the head for all styles with a right angle under the head, and inclusive of the countersink for countersunk heads.

The diameter of Screws is measured by the American Screw Gauge, the equivalent in inches being:

0 .0578	5 .1236	10 .1894	15 .2552	22 .3474
1 .0710	6 .1368	11 .2026	16 .2684	24 .3737
2 .0842	7 .1500	12 .2158	17 .2816	26 .4000
3 .0973	8 .1631	13 .2289	18 .2947	28 .4263
4 .1105	9 .1763	14 .2421	20 .3210	30 .4526
				34 .5053

The diameter of Rivets is measured by the old Standard Birmingham Wire Gauge, the equivalent in inches being:

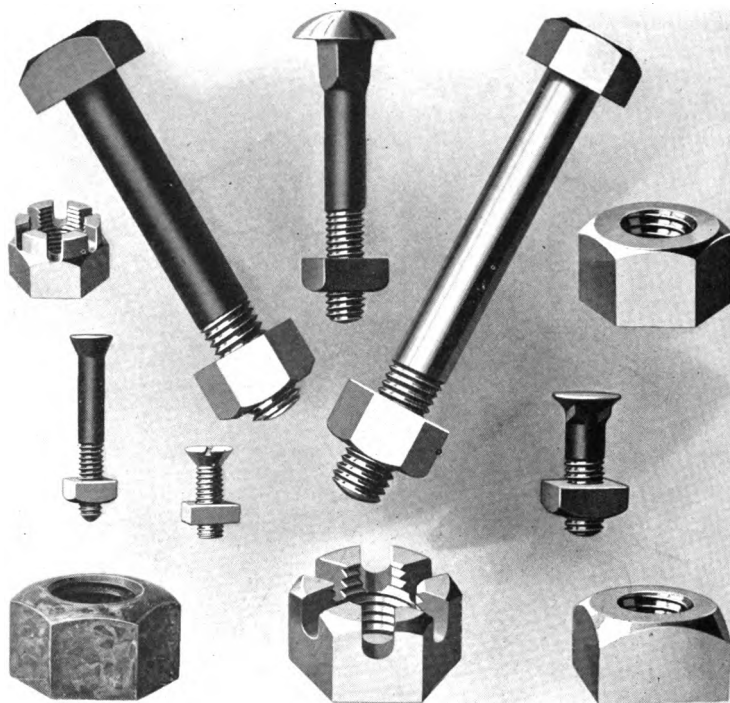
000 .425	2 .284	6 .203	10 .134	14 .083
00 .380	3 .259	7 .180	11 .120	15 .072
0 .340	4 .238	8 .165	12 .109	16 .065
1 .300	5 .220	9 .148	13 .095	17 .058
				18 .049

RUSSELL, BURDSALL AND WARD BOLT AND NUT COMPANY

PORT CHESTER, N. Y.

ROCK FALLS, ILL.

BOLTS AND NUTS



226

**Manufacturers of
All kinds of**

Carriage Bolts
Machine Bolts
Coupling Bolts
Stud Bolts
Tap Bolts
Plow and Cultivator
Bolts

Stove Bolts
Tire Bolts
Rivets and Special Bolts
of all descriptions
Cold Punched, Chamfered
and Trimmed Hexagon
and Square Nuts

A.L.A.M. Plain and Cast-
telled Nuts
Master Mechanics' Cas-
tle Nuts
Semi-finished, Full Fin-
ished and Case Hard-
ened Nuts

**Our Trade Mark:
"EMPIRE"**

signifies a certain standard of excellence that invites your investigation.

CATALOGUE SECTION
PART IV

**Air Compressors, Fans, Blowers
Pumping and Hydraulic Machinery
Drying and Crushing Machinery
Engineering Miscellany**

227

Pages 229-266

THE BLAISDELL MACHINERY CO.

BRADFORD, PA.

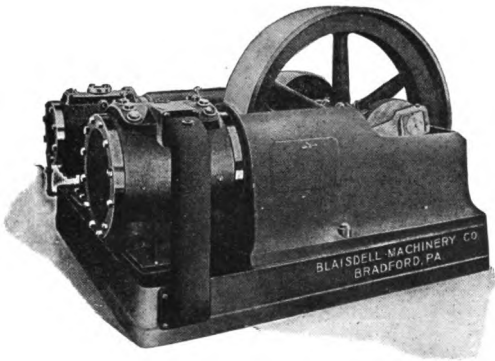
MANUFACTURERS OF AIR MOVING MACHINERY

AIR & GAS COMPRESSORS AND VACUUM CLEANING
MACHINERY

In All Sizes and Capacities

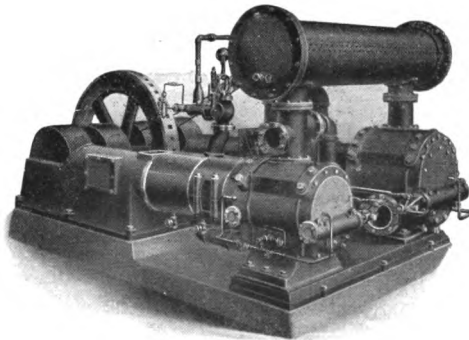
Descriptive catalogs, specifications, prices, etc., may be had on application to main office or to sales offices in all the principal cities.

BLAISDELL Single Acting, Belt Driven, Self Oiling, Single and Duplex Types. Enclosed frame, dust proof, and automatically lubricated throughout.



BLAISDELL Duplex, Two Stage, Self-Oiling Compressor. Can be furnished in belt or steam drive. Illustration shows Class CN, Belt Driven Compressor, Compound Air Cylinders.

BLAISDELL Two Stage Air and Cross Compound Steam Cylinders. Self oiling. Corliss inlet and poppet discharge valves. Illustration shows Class F2 Steam Driven Unit with Compound Air Cylinders and Overhead Intercooler.



INGERSOLL-RAND COMPANY

11 BROADWAY, NEW YORK, U. S. A.

Offices in all Principal Cities of the World

BUILDERS OF AIR AND GAS COMPRESSORS, BLOWERS, PNEUMATIC HAMMERS, PNEUMATIC DRILLS, AIR MOTOR HOISTS, AIR MOTORS, PNEUMATIC SAND RAMMERS, AIR LIFT PUMPS, AIR POWER MACHINERY OF ALL KINDS

PRINCIPAL PRODUCTS

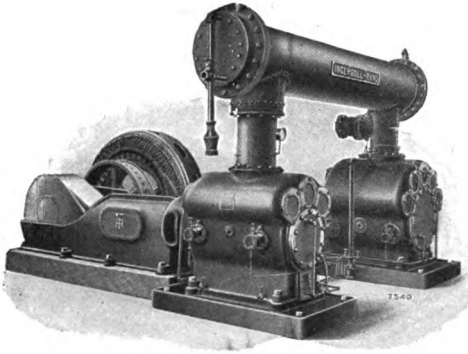
AIR COMPRESSORS	"LITTLE DAVID" RIVETERS
AIR HOISTS	"LEYNER" DRILL SHARPENERS
AIR LIFT PUMPING SYSTEMS	"LEYNER-INGERSOLL" WATER DRILLS
AIR DRILLS	PILE DRIVERS
"BUTTERFLY" ROCK DRILLS	PNEUMATIC TOOLS
"BUTTERFLY" HAMMER DRILLS	PORTABLE COMPRESSORS
"CALYX" CORE DRILLS	"RADIALAXE" COAL CUTTERS
CAMERON STEAM PUMPS	REHEATERS
CAMERON CENTRIFUGALS	"RETURN-AIR" PUMPING SYSTEMS
CHIPPING HAMMERS	RIVETING HAMMERS
COAL PUNCHERS	RIVET FORGES
CUPOLA BLOWERS	ROCK DRILLS
"ELECTRIC-AIR" ROCK DRILLS	SAND RAMMERS
"ELECTRIC-AIR" CHANNELERS	STONE CHANNELERS
GAS COMPRESSORS	STONE TOOLS
GASOLINE-AIR ROCK DRILLS	SUBMARINE DRILLS
HAMMER DRILLS—AIR FEED	TURBO BLOWERS
HAMMER DRILLS—HAND	TURBO COMPRESSORS
HOISTS—"IMPERIAL"	TURBO EXHAUSTERS
HOISTS—"LITTLE TUGGER"	TURBO GAS POSTERS
"JACKHAMER" DRILLS	VACUUM COMPRESSORS
"JACKSTOPER" DRILLS	WAGON DRILLS
"LITTLE DAVID" DRILLS	

Catalogues covering any of these products furnished upon request.



INGERSOLL-RAND COMPANY

"INGERSOLL-ROGLER" AIR COMPRESSORS



This type combines among many important features the "Ingersoll-Rogler" air valve—simple in design, durable, noiseless and efficient in operation.

Straight line machines are built both stationary and portable, driven by belt, gear, noiseless chain, direct connected oil engine and balanced piston valve steam engine.

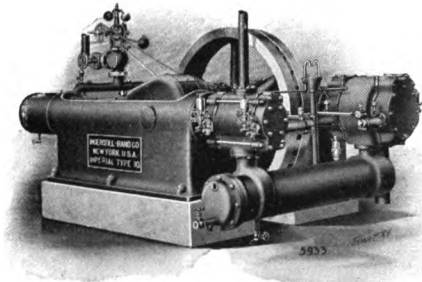
Duplex types are belt, rope, direct connected electric motor and Corliss steam engine driven.

The line includes single, two, three and multi-stage

machines in capacities from 10 to 50,000 cubic feet of delivered air—pressures from vacuum to 1000 pounds gauge.

Bulletins 3024, 3030 and 3031.

"IMPERIAL" AIR COMPRESSORS

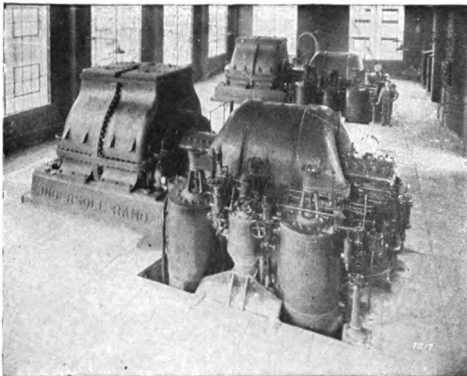


The "Imperial" has been long and favorably known to the trade. Every refinement has been employed to make the "Imperial" a highly efficient and economical machine.

It is built in both power and steam driven types with duplex single or two stage air cylinders. Steam cylinders are balanced Piston Valve with automatic cut-off control and Corliss valve.

Capacities range from 200 to 2900 cubic feet—pressures from vacuum to 500 pounds.

Bulletins 3311, 3312 and 3033.



TURBO BLOWERS AND COMPRESSORS

The Company is prepared to build Turbo Blowers and Compressors for all industrial purposes, Turbo Gas Boosters for high pressure gas transmission, Cupola Blowers and Gas Exhausters.

Full information upon request.

INTERNATIONAL STEAM PUMP CO.

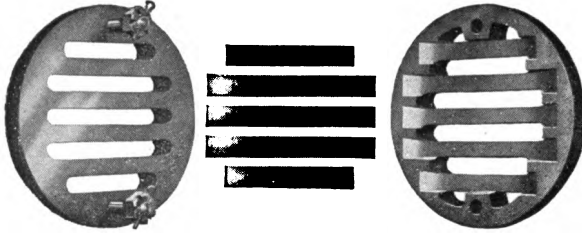
115 BROADWAY, NEW YORK

LAIDLAW DUNN GORDON PLANT, CINCINNATI, OHIO

AIR AND GAS COMPRESSORS. PUMPING MACHINERY. VACUUM PUMPS

THE LAIDLAW FEATHER VALVE (PATENTED)

For Air and Gas Compressors



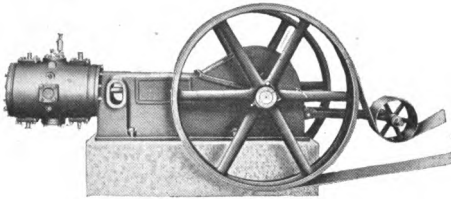
This valve represents the first complete solution of what has hitherto been the most difficult problem in air compressor designing.

This valve is of the voluntary type, consisting of three elements only: a ground face slotted seat over which slots are placed thin strips of non-corrosive ribbon steel, restrained in position but not rigidly held by a milled curved guard. The valve in opening flexes against the curve of the guard, permitting large passages for the flow of air, the ends of the valve strips remaining in contact with the seat at all times.

The valve seats by contact and not by impact; the ends of the valve never leaving the seat, consequently its seating is not a slam or impact but an increasing contact from the ends towards the center.

The extreme lightness and flexibility of the valve permits a minimum of resistance to the passage of the air, its flexibility insures tightness; the absence of impact insures quietness and durability.

The extreme simplicity, its astonishing durability and quietness and the unusual economies have been responsible for a most enthusiastic following among the trade.



Single Belt Driven Compressor

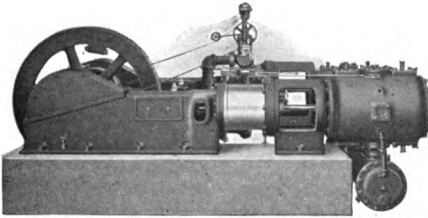
SINGLE POWER DRIVEN FEATHER VALVE COMPRESSORS

Built in displacements from 100 to 500 cu. ft. per minute, enclosed self-oiling frames, feather air valves, removable main bearing shells, bored cross-head guides and steel crosshead with bronze top and bottom slippers. BULLETIN L-531-68.

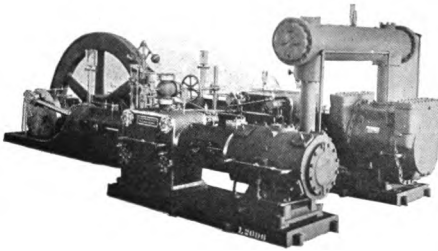
LAIDLAW FEATHER VALVE MOTOR DRIVEN COMPRESSORS built in capacities from 100 to 7500 cu. ft. per minute and may be direct connected, arranged for close belt drive or any other means of driving. Compressor is arranged with the most efficient controller to regulate the volume of air compressed, being entirely automatic and free from the necessity of frequent attention. BULLETIN L-530-68.



INTERNATIONAL STEAM PUMP CO.

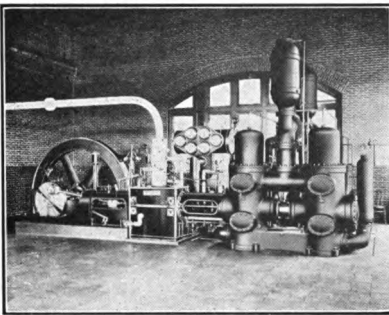


LAIDLAW STEAM DRIVEN FEATHER VALVE COMPRESSORS built in both the single and duplex type, with plain slide or Meyer cut-off steam valves. Frames use the same enclosed self-oiling patterns as on power driven compressors. The Laidlaw Feather Valve insures ideal performance and economy on the air end. This type may be had with compound steam cylinders under very attractive economy performances.

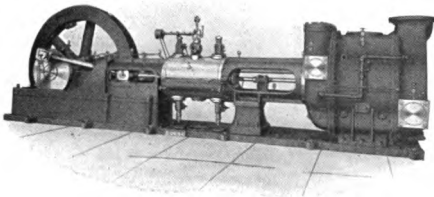


THE LAIDLAW CORLISS FEATHER VALVE COMPRESSOR embodies every refinement known to engine and compressor designers, resulting in the delivery of compressed air at the lowest possible cost. This type combines the economy to be obtained by the Laidlaw Feather Air Valve with that of the Laidlaw Corliss High Speed Latch Steam Valve designed and perfected exclusively

for air compressor service. Laidlaw Corliss Compressors are built in sizes from 1000 to 8000 cu. ft. per minute and for any pressure not exceeding 4000 lbs. per square inch. Bulletin L-523-A-68



The Laidlaw Dunn Gordon Plant builds a wide range of high duty crank and flywheel pumping machines of both the duplex and three cylinder types and with Meyer cut-off and Corliss steam valves. The **LAIDLAW DUNN GORDON THREE CYLINDER HIGH DUTY ELEVATOR PUMP** occupies a practically exclusive field in furnishing power for hydraulic elevator installations.



LAIDLAW DUNN GORDON SINGLE AND TWO STAGE VACUUM PUMPS fitted with Cincinnati vacuum gear, represents the highest commercial development in dry vacuum pumps for central station service. The Cincinnati gear adapts itself peculiarly to this service because of its very small clearance, positive action and the double protection of the poppet and rotary valves

against leakage. This pump is well and favorably known in every large power plant in the country. Steam valves of the Meyer, Corliss or poppet type can be supplied.

NATIONAL BRAKE & ELECTRIC CO.

WORKS AT MILWAUKEE, WIS.

DISTRICT SALES OFFICES:

165 Broadway
New York

827 Railway Exchange
Chicago, Ill.

318 Security Bldg.
St. Louis, Mo.

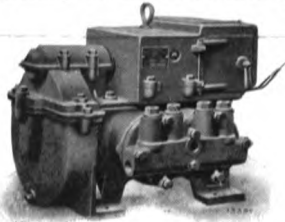
9th and Penn Ave.
Pittsburgh, Pa.

**MANUFACTURERS OF NATIONAL AIR COMPRESSORS, BOTH
STATIONARY AND PORTABLE, MOTOR, GAS, AND BELT DRIVEN**

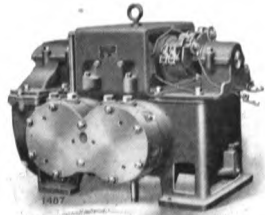
The National Brake & Electric Co. are the pioneers in the designing and building of motor-driven air compressor units. Its products are designed by specialists of extended experience in the art and are manufactured in shops especially equipped for the production of motor driven air compressors.

NATIONAL STATIONARY COMPRESSORS

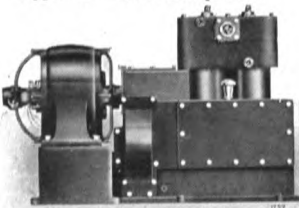
Primarily these compressors were designed for use in connection with air brake equipments in electric cars, a service requiring an unusual degree of efficiency, reliability, compactness, ease of access and quiet operation. They have been carefully developed to their present state of perfection and embrace advanced features of construction.



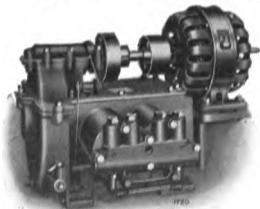
Type "H"—D. C. Compressor



Type "L"—D. C. Compressor



Type "E"—D. C. Compressor



Type "H"—A. C. Compressor

TYPE "H"—D. C. MOTOR DRIVEN

These compressors with capacities ranging from 11 to 50 cubic feet of free air per minute are built for pressures not exceeding 100 pounds unless otherwise specified. They are equipped with D. C. motors of the enclosed type and are built for intermittent service, with limited periods of work and rest.

TYPE "L"—D. C. MOTOR DRIVEN

When conditions necessitate a continuous supply of compressed air in small quantities, National Type "L" Compressors will be found singularly adapted to such requirements. This type of compressor is built in capacities ranging from 11 to 40 cubic feet of free air per minute and designed for pressures not exceeding 100 pounds unless otherwise specified.

TYPE "E"—D. C. MOTOR DRIVEN

These compressors are built for continuous service in capacities of 50 to 100 cubic feet of free air per minute and for pressures not exceeding 100 pounds, unless otherwise specified.

TYPES "H," "L" AND "E"

A. C. Motor Driven—1, 2 and 3 phase

Standard polyphase induction motors require that the compressor be unloaded at the time of starting and all types H, L & E induction motor driven compressors (2 and 3 phase) are equipped with a manual unloader, unless otherwise specified. When complete automatic control is desired, polyphase alternating current motor driven compressors can be furnished with National Automatic Governor for closing and opening the motor circuits when the air pressure has reached a predetermined minimum or maximum, together with a National Centrifugal type Unloader, which automatically unloads the compressor at the time of shutting down and keeps it in an unloaded state until the motor has again been started and attained nearly its normal full speed.

Ask for Catalog F400

NATIONAL BRAKE & ELECTRIC CO.

TYPE "3VS"—A. C. AND D. C. MOTOR DRIVEN

The National Type "3VS" Air Compressor has been designed to meet the constantly increasing demand for a self-contained electrically driven air compressor unit.

The air compressors of this type have completely water-jacketed cylinders and cylinder heads are designed for continuous service, and are built in standard capacities of 50, 100, 150, 225 and 300 cubic feet of free air per minute.

Type "3VS" motor driven compressors are equipped with complete automatic controlling devices, which permit the starting of the direct current compressors with not to exceed one half full load current, and the alternating current compressors with not to exceed full load current. They are also equipped with automatic unloader and automatically controlled water valves. National combined automatic controlling devices for motor driven compressors are absolutely reliable and efficient.

TYPE "3VD"—A. C. AND D. C. MOTOR DRIVEN

This compressor is designed for continuous service and is built in one size only, having a piston displacement of 550 cu. ft. per minute, and is equipped with the same design of combined automatic controlling devices as the "3VS," except being arranged for higher duty.

NATIONAL STATIONARY COMPOUND AIR COMPRESSORS

TYPE "Q-L" AND "Q-E"—A. C. AND D. C. MOTOR DRIVEN

National Type "Q" Compressors, with capacities ranging from 7 to 70 cubic feet of free air per minute, are intended for service where conditions necessitate the constant delivery of air at high pressures, within the maximum limits, however, of either 200 or 350 pounds. In the latter instance, the compressor, in comparison with that rated at 200 pounds pressure, will have reduced displacement capacity to offset increased pressure.

NATIONAL PORTABLE AIR COMPRESSORS

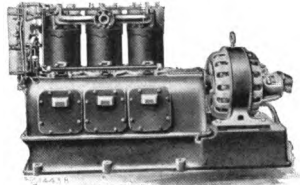
National Portable Air Compressor Outfits are ideally adapted for use in mercantile establishments, mines, quarries, manufacturing plants, and in construction work, where the available floor space is limited, or the nature of the work requires that a supply of compressed air be delivered in different places and under constantly changing conditions.

These portable outfits can be equipped with the same type of motor compressor and controlled in the same manner as any of the National Stationary Compressors previously described.

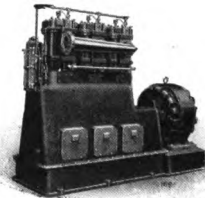
NATIONAL GAS DRIVEN AIR COMPRESSORS

With the increased adoption of gas motors there has been a constantly increasing demand for "National Air Compressors" driven by gas motors. These self-contained units of power will be found most efficient and economical for contracting and construction work, especially where electric power or steam is not available. The same superior features of design that characterize National Type "E" and "3VS" motor driven air compressors are embodied in National Type "E" and "3VS" Gas Driven Air Compressors.

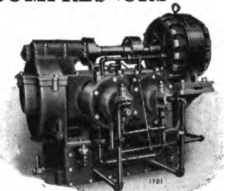
Ask for Catalogs F400 and F401



Type "3VS"—A. C. Compressor



Type "3VD"—A. C. Compressor



Type "QL"—A.C. Compressor



Type "H" Portable Compressor



Type "E" Gas Driven Portable Compressor

THE VILTER MANUFACTURING CO.

1194-1196 CLINTON ST., MILWAUKEE, WIS., U. S. A.

**BUILDERS OF ICE MAKING AND REFRIGERATING MACHINERY,
CORLISS ENGINES, AMMONIA FITTINGS**

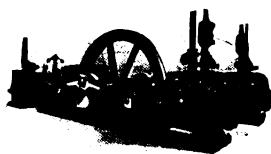


Fig. 1



Fig. 2

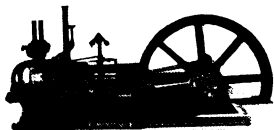


Fig. 3

Fig. 4. The standard frame is of box formation and is cast in one piece up to and including the 50 ton size. Above that size the pillow block section forms a separate casting. This type is built in sizes from 6 to 160 tons daily refrigerating capacity.

Fig. 5. The belt driven machines are furnished in both the standard and heavy duty styles, either single or duplex. These units may be driven by electric motor, gas or oil engines, etc. Single units built in sizes from 6 to 175 tons daily refrigerating capacity, duplex units in sizes from 12 to 750 tons daily refrigerating capacity.

STANDARD AMMONIA COMPRESSORS

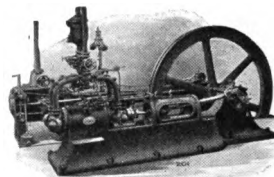


Fig. 4

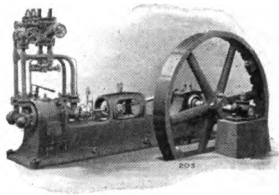


Fig. 5

SMALL CAPACITY VERTICAL AMMONIA COMPRESSORS

Fig. 6. A small single acting compressor, especially designed for users of comparatively small quantities of refrigeration. The design unites the base, main bearing and crank case in a single massive casting, cylindrical sections being used throughout, giving simplicity, symmetry and strength. Single units, either belt or steam driven, made in sizes from 1.11 to 12.6 tons daily refrigerating capacity. Duplex units, belt driven only, made in sizes from 2.22 to 25 tons daily refrigerating capacity.

LITERATURE

Bulletins, catalogs and full data regarding our products mailed on request.

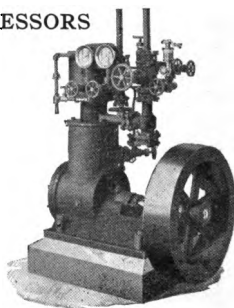


Fig. 6

MEADON'S BLOWER & PIPE WORKS

Founded 1870

BROOKLYN, N. Y.

MANUFACTURERS OF FANS, DUST COLLECTORS, SLOW SPEED-LOW POWER BLOWER AND PIPE SYSTEMS, SHEET IRON AND STEEL WORK

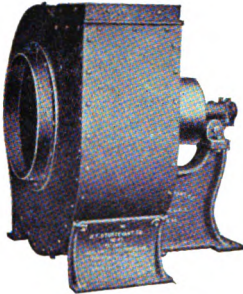
Engineers and Contractors for Slow Speed, Low Power, Dust Collecting systems for Buffing and Grinding Wheels, Wood Working Machinery, Tumbling Barrels, etc.



Meadon's Buffing Wheel System



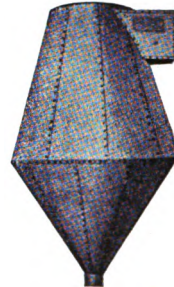
Meadon's System Applied to Wood Working Machines



Low Power Exhauster

Manufacturers of:

**Dust Collectors.
Saw Dust Separators.
Exhaust Fans.
Automatic Boiler Feeders.
Automatic Fire Dampers.
General Sheet Iron and
Steel Work.**



Meadon's Dust Collector

SAFETY GUARDS

Steel, wire and expanded metal safety guards designed, manufactured and installed for belts, gears, shafting, engines and all special machinery. All guards guaranteed to comply with Insurance and State Labor Laws.

GENERAL CONTRACTORS FOR:

Sheet Iron and Steel Work, Angle Iron and Light Structural steel work, piping, tanks, duct work, factory trucks, exhaust heads, ventilators, stacks, boxes, housings, angle iron racks, factory trucks, ovens, etc.

References and catalogues on request.

Estimates and blue prints furnished gratis.

AMERICAN BLOWER COMPANY

DETROIT, MICHIGAN

MANUFACTURERS OF HEATING, VENTILATING, COOLING, PURIFYING, HUMIDIFYING, DRYING, MECHANICAL DRAFT AND BLAST EQUIPMENT; VERTICAL SELF-OILING STEAM ENGINES, STEAM TRAPS; FANS AND BLOWERS FOR ALL PURPOSES

"Sirocco"
TRADE MARK

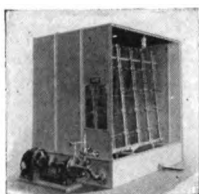


Fig. 1

SYSTEM OF PURIFYING, COOLING AND HUMIDIFYING

For Purifying and Humidifying air in Schools, other Public and Semi-Public Buildings.

For Humidifying and Cooling air in Textile Mills, Macaroni Drying Plants, Printing Houses, etc.

For Dehumidifying and Cooling in Candy Factories, Bakeries, Photo Film Drying Rooms, Blast Furnaces, Electric Generators, etc.

Capacities from 3,500 C.F.M. to 350,000 C.F.M.

Write for "detail" information.

Fig. 1 shows "Sirocco" Air Purifier—Cooler—Humidifier and Dehumidifier.

MULTI-BLADE FANS AND BLOWERS

For Heating, Ventilating and Cooling in Public, Office, Industrial and Educational Buildings.

For Drying and Mechanical Draft. Sirocco Multi-Blade Fans will handle more air consuming less power than the ordinary steel plate fan, having twice the wheel diameter.

Built with capacities of from 75 C.F.M. to 1,000,000 C.F.M.

Complete specifying information at your request.

Fig. 2 shows "Sirocco" Multi-Blade Fan. Arrangements for Pulley—Motor or Engine drive.

Fig. 3 shows "Sirocco" Multi-Blade Fan wheel.

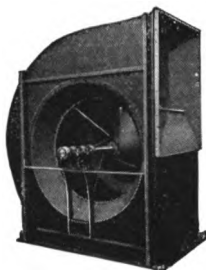


Fig. 2



Fig. 3

TYPE "E" EXHAUST FANS FOR EXHAUSTING AND CONVEYING SYSTEMS

For removing emery dust—saw dust, etc., a regular type "E" wheel is used—same housing, etc. For work in Cooperage and Excelsior Factories—wood pulp mills or other plants where shavings are long and stringy, lint from buffing and polishing wheels etc., a long shavings wheel is used—same housing, etc., special wheels for conveying cotton and wool.

Capacity tables, etc., upon request.

Fig. 4 shows Type "E" Fan pulley drive; built also for motor drive.

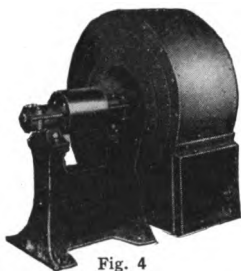


Fig. 4

TYPE "P" SPECIAL STEEL PRESSURE BLOWERS FOR FURNACE AND CUPOLA SERVICE

For supplying draft to Oil and Gas Furnaces, Cupolas—Sintering—Smelting and Pulverized Coal machines.

For blowing scale from dies in drop forge plants. Bearings being on independent foundations precludes vibration in the housings.

Built with pressures from 1 to 24 ounces.

Ask for complete working data.

Fig. 5 shows Type "P" Special Steel Pressure Blower. Built to discharge at any angle.



Fig. 5

AMERICAN BLOWER COMPANY

BRANCH OFFICES

NEW YORK, CHICAGO, PHILADELPHIA, PITTSBURG, ROCHESTER, ATLANTA, MINNEAPOLIS, ST. LOUIS, BOSTON, INDIANAPOLIS, KANSAS CITY, SAN FRANCISCO, LOS ANGELES, SEATTLE, DALLAS, with works at TROY, N. Y. and CANADIAN SIROCCO COMPANY, LIMITED, WINDSOR, ONTARIO.



"ABC" TYPES "A" SINGLE CYLINDER—"E" DOUBLE CYLINDER—"X" COMPOUND-VERTICAL, SELF-OILING STEAM ENGINES

Type "A" Engines develop up to 60 H.P. For School or other work where steam pressure is limited to 30 pounds—advocate Type "A" Low Pressure Engines, develop up to 40 H.P.

Type "E" Engines develop up to 120 H.P. This Engine is advantageous where more than 40 H.P. and fairly high rotative speed is required and only small space available.

Type "X" Engines develop up to 120 H.P. This compound engine is a very conservative steam consumer for H.P. developed. Same space requirements as for Type "E." Complete information on all types at your request.

Fig. 6 shows "ABC" Engine direct-connected to dynamo for generating electric current.

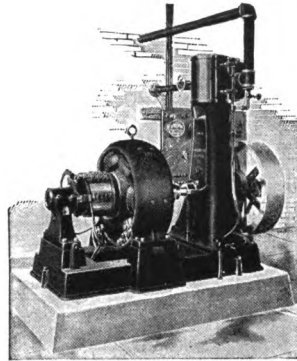


Fig. 6

"DETROIT" AUTOMATIC STEAM TRAPS, RETURN-SEPARATING-VACUUM AND CONDENSING (TILTING TYPE)

For all steam heated systems or machinery under any pressure.

For automatically returning condensation from whatever source directly to boiler without pumping.

A few applications in which Detroit Traps are successfully used: To drain Lumber—Brick—Laundry—Beet Sugar—Veneer and Paper Dryers—Hot Rolls in Textile Mills—Vacuum systems—Vulcanizing Machinery, etc.

Any condensation handling problem can be economically solved by the use of "Detroit" Traps.

Fig. 7 shows "Detroit" Automatic Return Trap.

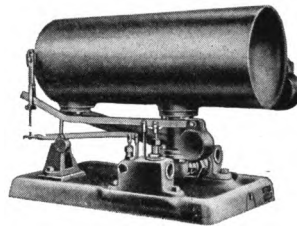


Fig. 7

TYPE "V" UNIVERSAL BLOWERS AND EXHAUSTERS

Four angles of discharge Right hand drive and four angles of discharge Left hand drive can be made from one type "V" Universal Fan—(aside from various angular discharges). For all Blowing and Exhausting work requiring up to four ounces pressure. Built for either pulley or motor drive.

Write for latest Bulletin.

Fig. 8 shows Type "V" Bottom Horizontal Right Hand Universal Fan. Pulley drive.

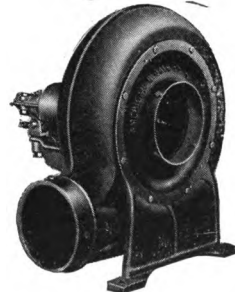


Fig. 8

"VENTURA" DISC VENTILATING FAN

For delivering large volumes of air at low pressure or against small resistances.

Low price—Small power consumption and inexpensive to install.

For Ventilating rooms and buildings—Ventura, motor driven, ventilating fans 650 C.F.M. to 17,500 C.F.M.

For ventilating small mines or at any mine where a disc fan can be used—Engine or Motor driven—from 12,000 C.F.M. to 100,000 C.F.M. resistance not to exceed 1" W.G.

Write for complete information.

Fig. 9 shows Ventura motor driven Ventilating fan.



Fig. 9

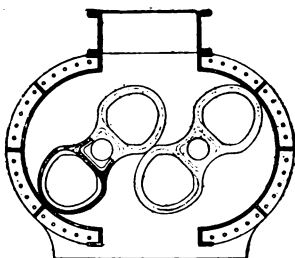
P. H. & F. M. ROOTS COMPANY

HOME OFFICE, CONNERSVILLE, IND.

NEW YORK OFFICE, 120-122 Liberty St.

CHICAGO OFFICE, 1245 Marquette Bldg.

MANUFACTURERS OF ROTARY POSITIVE PRESSURE BLOWERS, GAS EXHAUSTERS, PUMPS, FLEXIBLE ROPE COUPLINGS



Sectional View Showing Interior Construction

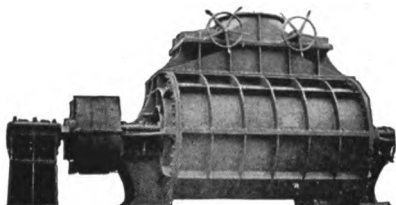


ROTARY BLOWERS

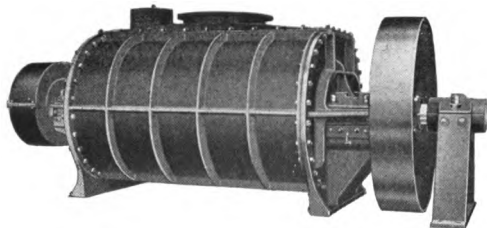
The air from the suction side follows the movement of the impeller lobe until the opposing lobe traps it between the case and the impeller after which the continued revolution brings the air to the discharge side where the rolling together of the impellers prevents its return.

SMELTING BLOWERS

These Blowers of full length are nominally built for two pounds pressure but they are capable of operating under two and one-half pounds. All bearings are quarter box constructed, with removable shells to meet hard service, easy adjustment and quick renewal. Sizes range up to 400 foot machines.



Smelting Blower, Single Geared, Double Outboard Bearing with Double Acting Quick Opening Blast Gate



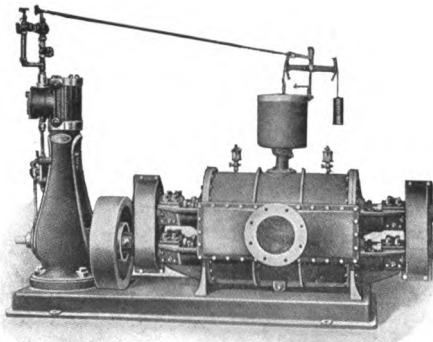
Foundry Blower with Pulley and Outboard Bearing

FOUNDRY BLOWERS

Used for Cupolas, Oil Furnaces and any Low Pressure Service.

GAS EXHAUSTERS

Our Exhausters are used for handling Foul Gas and High Pressure Booster Service. We can meet any condition of capacity or pressure up to and including ten pounds pressure.



Gas Exhauster, Engine Drive, Float Governor



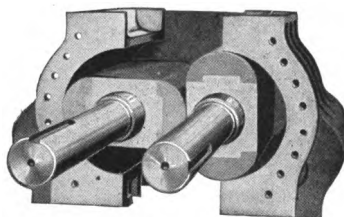
P. H. & F. M. ROOTS COMPANY



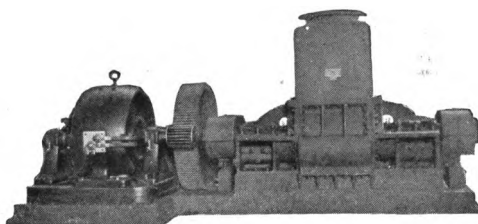
ROTARY WATER PUMPS

Briefly, the operation of the Pumps is as follows: The revolution of the shafts and impellers traps the water between the lobes and the case, delivers it to the discharge side, where the rolling together of the impellers on the center lines of the shaft prevents the return of the water.

These Pumps handle any liquid substance not containing grit, under any head from ten to two hundred feet, with an economy ranging from 75 per cent to 85 per cent of the power applied to the Pump shaft.



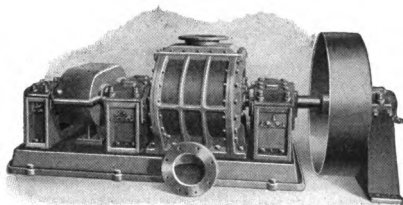
Interior Construction of Rotary Pump



Direct Connected Motor and Pump

ROTARY VACUUM PUMPS

In the design of these Vacuum Pumps we have been guided by results obtained in their operation. These Pumps are all built for down discharge because this construction relieves them of all shock and vibration due to discharging water. All Pumps are furnished with our patented leather stuffing box which is kept soft with water.



Vacuum Pump with Pulley and Outboard Bearing

FLEXIBLE ROPE COUPLINGS

This Coupling is now used on a large percentage of our direct connected Blowers, Exhausters and Pumps. The points of advantage that place it ahead of other designs for the same purpose are these:

First—It corrects for misalignment in any direction whether due to settling of foundations, wear of engine bearings, or original setting, thus saving uneven wear and heating.

Second—It takes care of end thrust caused by heating, wear of bearings or oscillations of the driving mechanism.

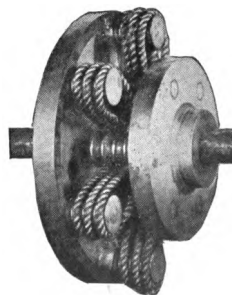
Third—It eases up sudden fluctuations of load by the swing of the loop.

Fourth—It permits rotation in either direction, with equal results and symmetrical positions.

Fifth—The ropes can be removed as quickly as the bolts in a solid coupling can be taken out.

Sixth—With ropes off, either the driving or driven machine can be rotated without interference.

Seventh—The life of the ropes is long and they can be renewed at small expense.



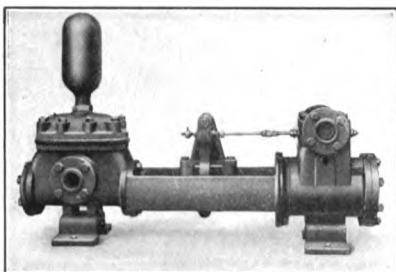
Flexible Rope Coupling

THE BLAKE & KNOWLES STEAM PUMP WORKS

MAIN OFFICE: 115 BROADWAY, NEW YORK

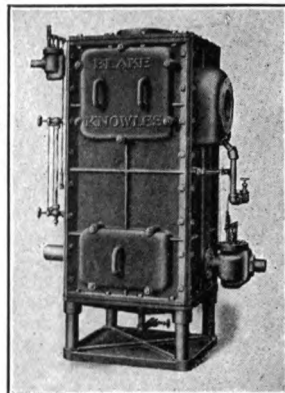
FACTORY: EAST CAMBRIDGE, MASS.

Branch Offices in all Principal Cities



FEED
WATER
HEATERS

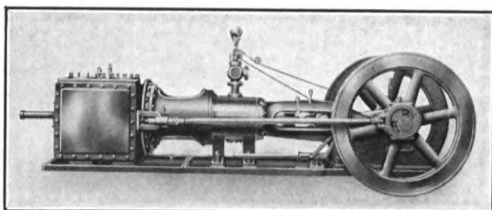
Open and
Closed
Types



IMPROVED SIMPLEX PUMPS

For Boiler Feeding, Pressure,
Tank and Vacuum Service.

Horizontal and Vertical Patterns



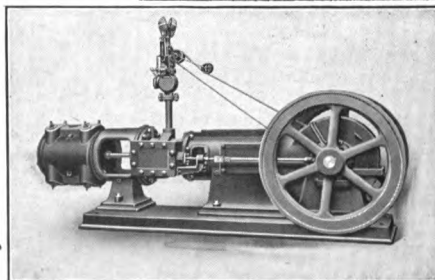
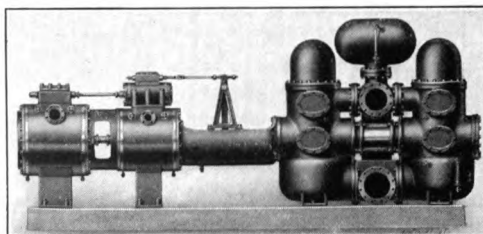
ROTATIVE DRY VACUUM PUMPS

Steam and Power

For High Vacuum Service

SINGLE COMPOUND PLUNGER PUMPS

For Boiler Feeding,
Elevator Service, etc.



CLIMAX ENCLOSED FRAME AIR COMPRESSORS

Single and Duplex: Steam or Power Driven

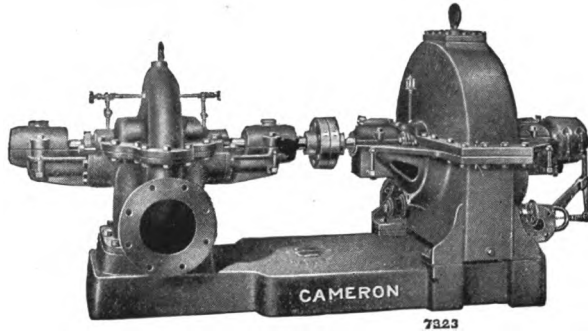
B244,8

A. S. CAMERON STEAM PUMP WORKS

11 BROADWAY, NEW YORK

DESIGNERS AND BUILDERS OF CENTRIFUGAL AND TRIPLEX ELECTRIC PUMPS; SIMPLE AND COMPOUND, PISTON AND PLUNGER PUMPS FOR ALL CLASSES OF SERVICE

CAMERON DOUBLE SUCTION VOLUTE PUMP



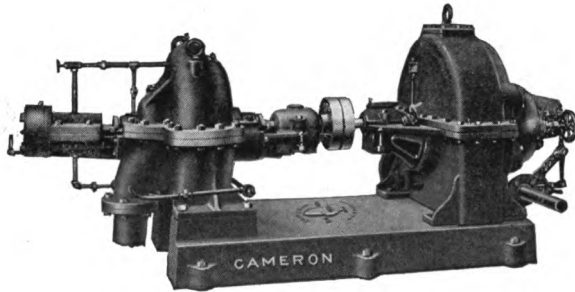
Cameron Centrifugal Pumps are the most modern in design, and they give the highest efficiencies.

The Double Suction Volute Pump is especially adapted for general service. The casing is horizontally split, allowing quick, easy access to all working parts. The impeller is enclosed, and perfectly balanced. Built for capacities from 50 to 12000 gallons a minute. Can be direct-connected to steam turbine or other forms of power drive.

Bulletin No. 150

243

CAMERON MULTI-STAGE TURBINE PUMP



The Cameron Multi-stage Turbine Centrifugal Pump is simple and compact, strong and dependable. All parts accessible by means of the horizontally split casing.

This pump gives an exceptionally high efficiency over a wide range of capacity. The cost of upkeep is very low.

It is built in two, three and four stages for a wide variation of speed and capacity, and may be driven by steam turbine or any available motive power.

Bulletin No. 151

Cameron Steam Pumps have fewer working parts than any other steam pump, and none exposed. Only four pieces in the Steam Mechanism. By merely removing the valve chest cover on the water end the whole interior of the valve chamber is plainly visible.

All the way through it is compactly and ruggedly constructed.

Built in many types and sizes for all classes of service.

Bulletin No. 104

THE DEMING COMPANY

SALEM, OHIO, U. S. A.

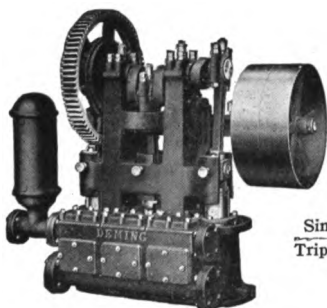
NEW YORK OFFICE AND STOCK: 152 Chambers Street

MANUFACTURERS OF HAND AND POWER PUMPS FOR ALL USES

SINGLE AND DOUBLE ACTING TRIPLEX PUMPS

ARTESIAN WELL PUMPS AND CYLINDERS

For Operation by Electric Motors, Gas or Gasoline Engines or Belt from Shaft



Single-Acting
Triplex Pumps

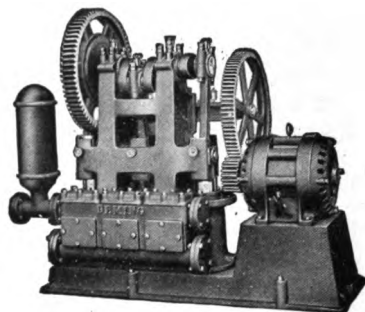


Fig. 50, Size 7x8 to 8 1/2 x 8.

Made in sizes from 2x2 to 13x14, with capacities of 300 gallons to 58,000 gallons per hour. For Waterworks, Boiler Feeding, General Water Supply, etc.

Fig. 50, Size 5 1/2 x 8 with Type "B" Drive.

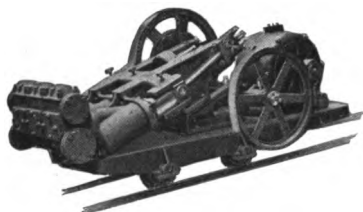


Fig. 70, 5x6, Portable Electric Mine Pump
Made in sizes from 3 1/2 x 4 to 8 1/2 x 8, with capacities of 1,800 gallons to 18,000 gallons per hour.

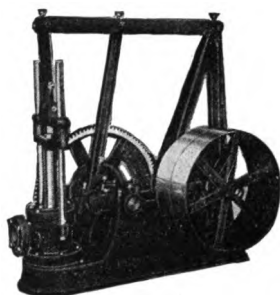
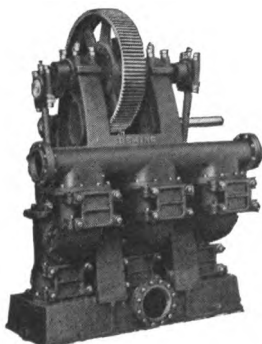


Fig. 62, 10-inch Stroke.
Made in three strokes, 10, 16, and 24". For Wells 300 ft. deep or less.



Single-Acting Triplex Stuff Pump
for 75 lbs. Maximum Pressure.
For Handling Paper Stock and Thick Liquids. Made in sizes from 4x6 to 11x12.

Complete
192 Page
Power Pump
Catalogue
Mailed to
Engineers
on Application.

Deming Triplex Power
Pumps Effect an
Actual Saving
of 33 1/3 %
over Steam Pumps.

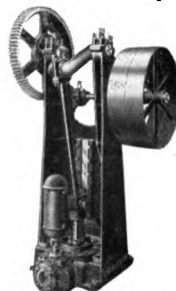


Fig. 80, Deep Well Power Working Head with Differential Plunger.
16" and 24" strokes. For Wells 725 ft. deep or less.

D'OLIER CENTRIFUGAL PUMP AND MACHINE COMPANY

MORRIS BLDG., PHILADELPHIA, PA.

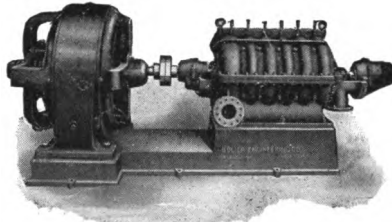
ENGINEERS AND MANUFACTURERS

D'OLIER CENTRIFUGAL VOLUTE AND TURBINE PUMPS
FOR WATER WORKS AND IRRIGATION, FIRE SERVICE, BOILER FEED, MINE DRAIN-
AGE, CONDENSER SUPPLY, SEWAGE, FILTRATION SYSTEMS,
HYDRAULIC MINING, AND GENERAL SERVICE

Pumps carefully designed and
built for particular service required.

Complete Pumping and Power
Plants installed.

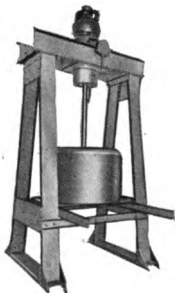
We manufacture only a high
grade, high efficiency pump, using
the best grade of materials through-
out. The impellers are accurately
designed and carefully finished,
thereby insuring maximum effi-
ciency.



6"-6 Stage D'Olier Turbine Pump.
700 G. P. M. at 700 ft. total head

D'OLIER CENTRIFUGAL MACHINES

For sugar, chemicals, sewage, oil and waste reclaiming, clarifying and filtering
and textile work. Belted, electric motor or steam turbine driven. *Special
Centrifugals, especially those for extreme High Speeds, designed and built.*



Electric Centrifugals

STANDARD ELECTRIC CENTRIFUGALS

"D'Olier Improved Weston" type with ball bearings
—single non-adjustable buffer and unit steel supporting
framing. Designed for heavy duty and highest efficiency.
For sugar work, textile, chemi-
cals, etc.—a strictly high grade
machine of rugged construction.

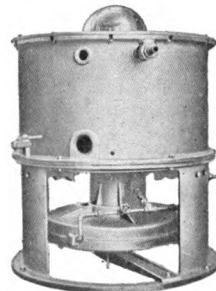
NITRATING CENTRIFUGALS

D'Olier patent S.S.B.B. type.
Thoroughly proven machines,
extremely reliable and efficient.

D'OLIER COMBINED OIL EXTRACTING AND WASHING CENTRIFUGALS

Improved "Weston self-balancing" type machines
for separating and reclaiming oil from wiping waste,
machinery wiping towels, rags, etc. Washing and dry-
ing waste, towels and other materials.

Recovering oil from automatic machined parts,
metal chips, turnings and scrap, and like economic uses.



"D'Olier Improved West-
on" Type Combined Oil
Extracting and Washing
Centrifugal

APPARATUS FOR SEWAGE TREATMENT AND UTILIZATION OF TRADE WASTES

Riensch-Wurl screens and highly efficient apparatus and equipment for
Mechanical Treatment of sewage and recovery of by-products.

*D'Olier Sludge Reduction Machines
and*

Specially designed centrifugals for purging sludge and screenings.
Pumps for Sewage and Sludge *Apparatus for the recovery of Sludge values*
Send for Bulletins

THE GOULDS MANUFACTURING CO.

SENECA FALLS, N. Y.

BRANCH HOUSES: BOSTON, NEW YORK, ATLANTA, CHICAGO, HOUSTON

PUMPS AND HYDRAULIC MACHINERY

The Goulds Line includes hand and power pumps for every service.

For 65 years Goulds Reliable Pumps have been generally recognized as the world's standard of quality. They are built to operate with the least possible power and all parts are made of the best materials to give long reliable service. They are rated conservatively, and every Goulds Pump is guaranteed to give reliable, satisfactory service under the conditions for which it is recommended.

They are adapted for belt drive or direct connection to electric motors, gas engines, steam turbines, water wheels, or other drivers. A few typical pumps from the line are illustrated on the opposite page.

SINGLE-ACTING TRIPLEX PUMP

For 130 Pounds Working Pressure or 300 Feet Elevation
General Water Supply, Municipal Waterworks, Boiler Feeding, Hydraulic Elevators, Mine Pumping, Pulp Grinders, etc.

Illustration: Size 8"x10"—Capacity 720 gallons to 21,000 gallons per hour.

Specifications

Frame	Close grained iron cast in one piece with crosshead guides and cylinders, forming exceptionally rigid construction and accurate alignment of all working parts.
Crank Shaft	High carbon open hearth steel, accurately machined to gauge.
Bearings	Crank shaft and pinion shaft bearings are of babbit metal.
Gearing	Gear and pinion, charcoal iron, machine cut from the solid. A gear guard covers the pinion and adjacent teeth of the gear. Gear ratio 5 to 1.
Crossheads	Babbitted and run in bored guides. 3½x4 in. and smaller crossheads, cast iron.
Connecting Rods	Fitted with adjustable bronze boxes at crank end (except 3½x4 in. and smaller sizes which have babbitted boxes) and bronze bushings at crosshead end.
Cylinders	Close grained iron cast in one piece with standards.
Plungers	Hard cast iron, accurately machined and ground true and smooth.
Glands	Iron and of easy access for adjustment.
Base and Valve Boxes	Charcoal iron in one casting, of liberal proportion, affording large valve area, direct waterways and easy access.
Valves	3x4 in. and smaller, bronze valves. 3½x4 in. and larger—for cold water, rubber discs on bronze grid seats with cylindrically wound springs. For hot water we recommend the grid seat valve with special disc.
Air Chamber	Supplied with Pump. Vacuum Chamber to order.
Special Construction	Phosphor Bronze Plungers, Lined Cylinders and Glands, Raw-hide pinion, etc., to order.

PUBLICATIONS

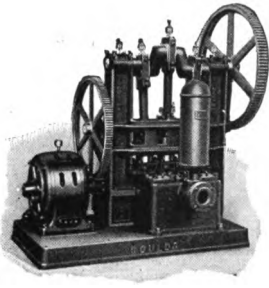
The following bulletins, any of which will be sent on request, give complete specifications on the various standard types of Goulds Power Pumps:

No. 100. Double-Acting, Single-Cylinder Piston Pumps.	No. 109. Pumps for Special Services.
No. 101. Single - Acting Triplex Plunger Pumps, Outside-Guided Type.	No. 110. Single-Stage, Double Suction Centrifugal Pumps.
No. 102. Single - Acting Triplex Plunger Pumps, Trunk Plunger Type.	No. 111. Centrifugal Sump Pumps.
No. 103. Single - Acting Triplex Plunger Pumps, Large Capacity and High Pressure Types.	No. 113. Rotary Pumps.
No. 104. Double - Acting Triplex Piston Pumps, Vertical Type.	No. 114. Vertical Single-Stage Centrifugal Pumps.
No. 105. Single-Stage, Single Side Suction Centrifugal Pumps, Open Impeller Type.	No. 115. Double - Acting Triplex Piston Pumps, Horizontal Type.
No. 106. Vacuum and Stuff Pumps.	No. 116. Single - Acting Triplex Pressure Pumps.
No. 107. Deep Well Triplex Pumps.	No. 117. Air Pressure and Vacuum Pumps.
No. 108. Deep Well Working Heads and Cylinders.	No. 118. Centrifugal Fire Pumps, Two and Three Stage.
	No. 119. Single Stage, Single Side Suction Centrifugal Pumps, Enclosed Impeller Type.

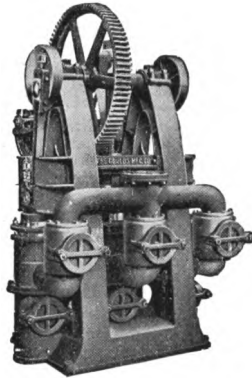
Bulletin on Multi-stage Centrifugal Pumps in course of preparation.

THE GOULDS MANUFACTURING CO.

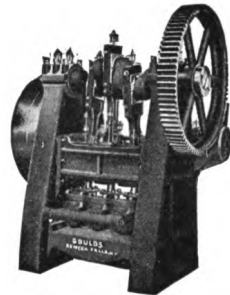
PUMPS FOR EVERY SERVICE



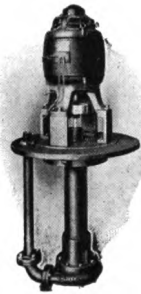
Single-Acting Triplex Pump



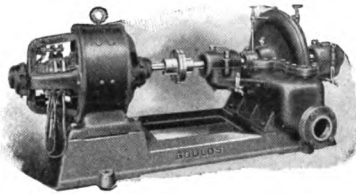
Stuff Pump



Triplex Pressure Pump



Centrifugal Sump Pump

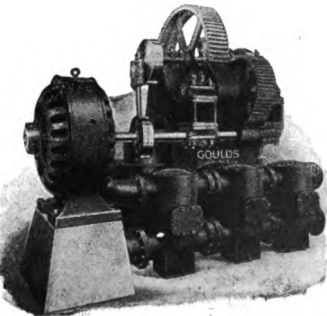


Single-Stage, Double-Suction Centrifugal Pump

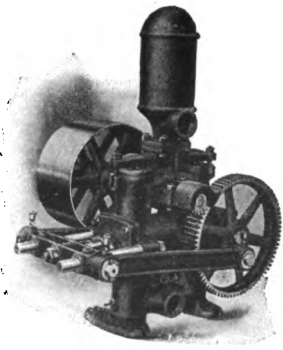


Deep Well Working Head

**These are only a few of the many types of Goulds Pumps
Ask for bulletins on Power or Hand Pumps
for any service in which you are interested.**



Double-Acting Triplex Pump



Double-Acting Single Cylinder Pump

KERR MACHINERY & SUPPLY CO.

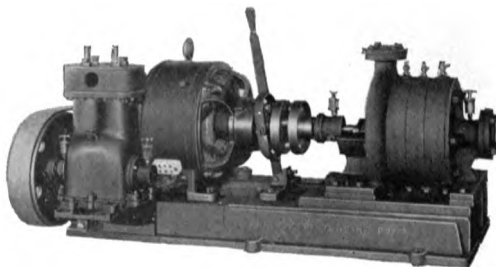
GENERAL OFFICES AND FACTORY

KERR BUILDING, DETROIT, MICH.

MANUFACTURERS OF BELT AND ELECTRIC DRIVEN PUMPING MACHINERY; SINGLE AND DUPLEX AUTOMATIC SEWAGE EJECTORS; MULTI-STAGE TURBINE PUMPS; HYDRO-PNEUMATIC SYSTEMS, BOOSTER SYSTEMS; AUTOMATIC SPRINKLER SYSTEM PUMPS; AND DIRECT CONNECTED, MOTOR DRIVEN VACUUM PUMPS

MULTI-STAGE TURBINE PUMP

Kerr multi-stage turbine pumps are designed and built for high efficiencies, small capacities, and high heads. Capacity ranges from 5 to 300 GPM. Enclosed type, balanced bronze impellers, main bearing of the combined thrust and radial ball type running in oil. Units mounted on heavy cast iron base plate.



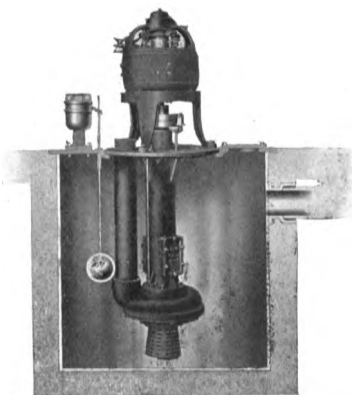
Kerr Combination Turbine Pump and Air Compressor

Size Suction	Size Discharge	Capacity Gallons per Minute	Speed Revolutions per Minute	*Head in Feet per Stage	*Horse Power per Stage
1	¾	5	1730—2200	30—50	½—¾
1½	1	20	1730—2200	25—40	¾—1
1½	1½	30	1730—2200	35—60	1—1½
2	1½	60	1730—2200	50—80	1½—3
2½	2	110	1730—2100	65—110	3½—6
3	2½	125	1730—2100	80—130	4½—7½
3	3	200	1730—2100	85—140	7½—12

*Multiply head per stage by number of stages for total head of pump and horse power.

KERR ELECTRIC DRIVEN VERTICAL EJECTOR PUMPS

Either Single or Duplex



Automatic Ejector Pump Showing Installation in Iron Basin, with Automatic Float Switch

The Kerr vertical, motor driven, Centrifugal Bilge Pump, or Ejector for pumping sewage, draining basements, etc., is entirely automatic in its action, and as the pump case is always submerged in the liquid to be pumped, no priming is necessary.

The motor is direct connected to the pump and is automatically controlled by a float, starting when the liquid reaches a given height in the pit and stopping when pit is empty. The pump, discharge pipe, etc., are supported from a motor floor plate providing for easy removal of the pump for inspection and repair.

Pump has a semi-enclosed bronze impeller, pump case bearing lined with high grade babbit, and a combined radial and thrust ball bearing on the motor floor plate.

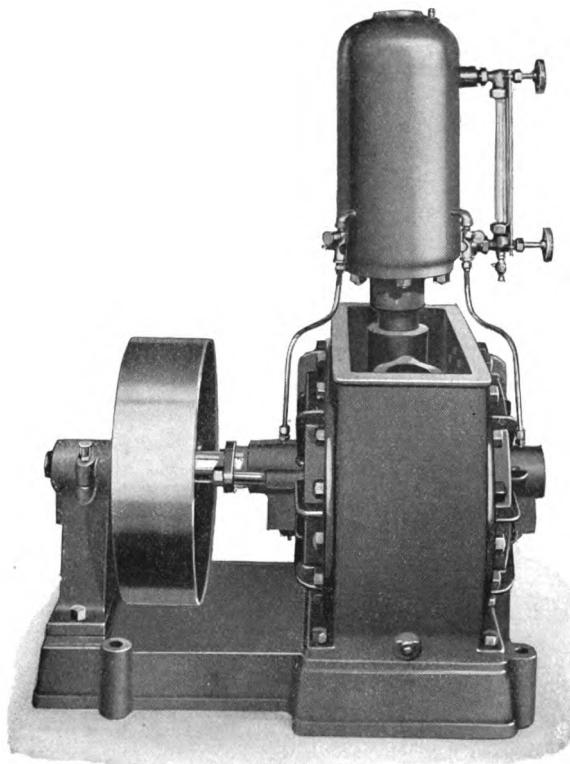
LAMMERT & MANN CO.

WOOD & WALNUT STS., CHICAGO, ILL.

ENGINEERS-MACHINISTS, MANUFACTURERS OF ROTARY VACUUM PUMPS, CENTRIFUGAL PUMPS, PRESSURE PUMPS

ROTARY DRY VACUUM PUMPS

Our pumps are designed for the *highest possible dry vacuum*. Made in several styles and sizes to meet the various demands of service.



Single Stage Water Cooled Pump

The smaller, light service pumps, which are capable of easily attaining a vacuum of 26 inches of mercury, are air-cooled, having exceptionally large radiating surface for that purpose.

The larger pumps are water-cooled and are capable of easily maintaining continuously a vacuum of 27 inches of mercury at sea level.

With the tandem high duty, water-cooled pumps we can maintain the highest possible vacuum.

CENTRIFUGAL PUMPS—CONTRACT WORK.

We also build rotary pumps to handle the heaviest products.



MANISTEE IRON WORKS CO.

MANISTEE, MICH.

Sole Manufacturers and licensees for the United States and Canada for the

REES RoTURBo PATENT PRESSURE CHAMBER PUMP, ROTARY JET CONDENSER, AND AIR PUMP



TRADE MARK

REES RoTURBo ROTARY PUMPS

The special feature of the Rees RoTURBo Pump lies in the construction of the impeller, which, instead of being built with a flat disc runner with the main object of securing velocity of water in the expanding channels of the fixed casing, is designed in the form of a drum, or pressure chamber, the object aimed at being to secure a constant pressure inside of the revolving impeller equivalent to the pressure required. The impeller having this large capacity, the water inside, as it approaches the rim, becomes practically stationary, relative to the impeller,—thus eliminating frictional losses and generating the pressure by centrifugal force.

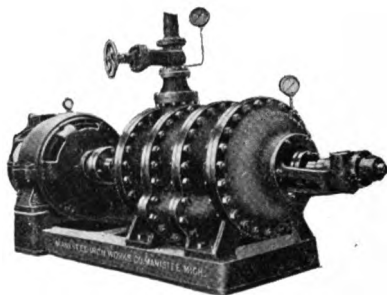
In the rim of the ranged a series of ing in a rearward di-blades have the effect tion of the pressure locity and owing to tion, the pressure in the drum is available for a turbine effect which increases with increased volumes of water flowing through the drum.



impeller there are ar-turbine blades point-rection and these of converting a por-in the drum into ve-their rearward direc-

The result of this turbine effect is to transfer the power, which would otherwise be absorbed by the motor or other driving mechanism, to the rim of the impeller, and, consequently the power taken by the motor never exceeds that required at normal duty of the pump, and at low heads, the power taken by the motor actually decreases. Owing to this self regulating feature of this type of pump, **IT IS IMPOSSIBLE TO OVERLOAD THE MOTOR.**

We invite your inquiries so that our Engineers can offer you our proposition, with full details, catalogues, and characteristic curves. We make pumps for all services, all sizes and stages, with any type of drive to suit your existing conditions.

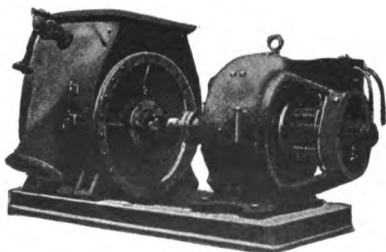


Rees RoTURBo Multi-Stage Pump, capacity 1,000 gallons per minute, 570 ft. head 1140 R.P.M.

REES RoTURBo ROTARY JET CONDENSERS

These can be driven by either Electric Motors, Steam Engines or Steam Turbines.

The vacuum attained is within a fraction of an inch of the theoretical possible. The condenser is extremely simple, having one Rotating Shaft and impeller only. There are no other moving parts whatever. The Rees RoTURBo Rotary Air Pump is on the same principle. Full details and quotations on application.



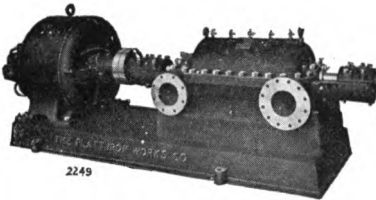
Rees RoTURBo Rotary Jet Condenser

PLATT IRON WORKS

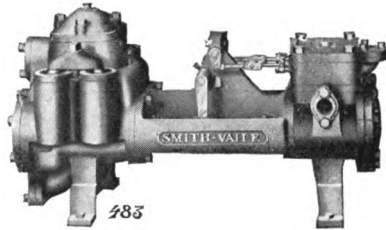
GENERAL OFFICES: DAYTON, OHIO

Branch Offices in all Principal Cities.

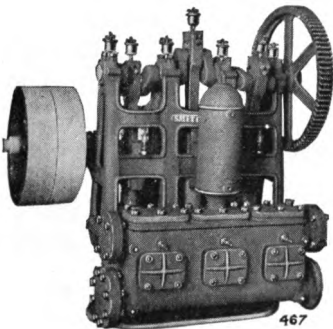
**CENTRIFUGAL AND TURBINE PUMPS, STEAM AND POWER PUMP-
ING MACHINERY, WATER WHEELS, FEED WATER HEATERS, AIR
COMPRESSORS, OIL MILL EQUIPMENT, CONDENSING APPARATUS**



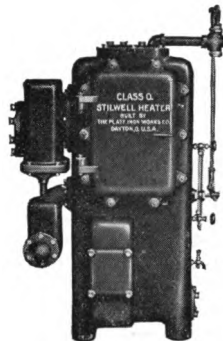
"PLATT" CENTRIFUGAL PUMPS
Single and Multi Stage, of all sizes—for
all classes of service.



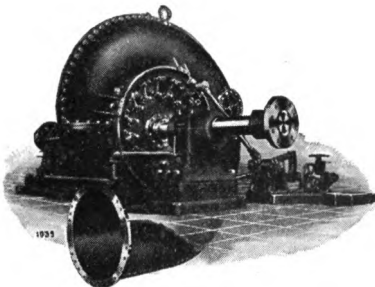
"SMITH-VAILE" STEAM PUMPS
In all sizes and types, from Boiler Feed to
Corliss Pumping Engines.



"SMITH-VAILE" POWER PUMPS
Duplex and Triplex, Horizontal and
Vertical.



"STILWELL" FEED WATER HEATERS
Open, Closed and Multi Current types.
Hot Water Service Heaters.



**VICTOR-FRANCIS TURBINE WATER
WHEELS**

Standard wheels for all Heads and Powers.
Special wheels for special developments.

We maintain a corps of specialists
in every department, thus assuring our
customers the best possible service.

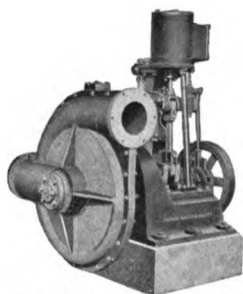
Catalogues, bulletins, drawings and
complete data covering our lines sent
on request.

MORRIS MACHINE WORKS

BALDWINVILLE, N. Y.

NEW YORK OFFICE: 39-41 CORTLANDT ST.

BUILDERS OF CENTRIFUGAL PUMPING MACHINERY, HYDRAULIC DREDGES, STATIONARY AND MARINE ENGINES

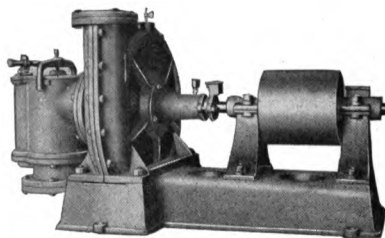


Standard Double Suction
Steam Pump

We build CENTRIFUGAL PUMPS for almost any service and of all types, including side suction and double suction, vertical or horizontal shaft. STAGE PUMPS for high heads. TWIN PUMPS for large capacities and high speeds. Or will design SPECIAL PUMPS to suit special conditions. As the oldest and largest firm in the country building exclusively this class of machinery, our experience of nearly fifty years has covered all services for which CENTRIFUGAL PUMPS have been used.

MORRIS CENTRIFUGAL PUMPS

are perfectly balanced, require small space and foundation; have high efficiency; are equally suitable for small up to very large capacities, and can handle sand or solids with the water without injury. These pumps direct connected to reciprocating engines are suitable for moderate heads, or direct connected to electric motor or steam turbine (or belt driven) for high heads. For heads above 100 feet, pumps are preferably built in stages.



Standard Horizontal Pump. Hand
Suction Primer Attached

The Standard Horizontal Pump is the type most extensively used for all purposes and for general work is the best pump on the market. These pumps in iron construction are listed below. Specifications for pumps above 20-inch furnished on application.

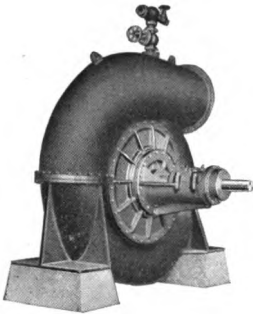
Write for new complete catalogue.

MORRIS IMPROVED STANDARD IRON HORIZONTAL PUMP

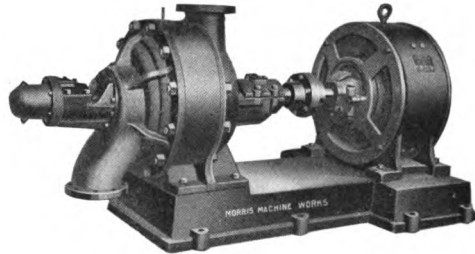
No. Pump (Diameter Discharge Opening)	Size Pipe Flange on Suction, Inches	Economical Capacity, for each Gallon per Minute	Horse-Power Required Pulley, Foot Head	Diameter and Face of Pulley in Inches	Floor Space Required in Inches, Without Primer	Shipping Weight Without Primer, Lbs.	Shipping Weight With Primer, Lbs.	No. Pump
1	1 1/4	30	.025	4x 3 1/4	12x 7	85	...	1
1 1/2	2	70	.058	6x 6	17x 31	175	220	1 1/2
1 3/4	2	90	.075	7x 8	21x 32	290	305	1 3/4
2	3	120	.10	8x 8	23x 37	350	415	2
2 1/2	3	180	.15	8x 8	24x 38	360	430	2 1/2
3	4	260	.22	8x 8	25x 39	415	495	3
4	4	470	.30	10x10	29x 41	615	720	4
5	6	735	.45	12x12	34x 54	940	1075	5
6	6	1050	.69	15x12	37x 55	1180	1345	6
8	8	2000	1.00	20x12	45x 64	2065	2430	8
10	10	3000	1.52	24x12	51x 69	2610	2940	10
12	12	4200	2.00	30x14	63x 71	3615	...	12
15	15	7000	3.50	40x15	77x 80	8250	...	15
15*	18	7000	3.50	30x15	60x 68	3350	...	15
18	20	10000	4.50	40x16	93x103	9000	...	18
18*	20	10000	4.50	30x16	66x 72	5800	...	18
20	22	12000	5.00	36x20	73x 83	7000	...	20
24*	24	15000	5.50	48x36	94x137	10800	...	24

* Refers to Low-Lift Pumps, which are recommended for heads up to 40 feet.

MORRIS MACHINE WORKS



30" Side Suction Pump



8" Two-stage High Pressure Pump. Direct
Connected to Electric Motor

When making inquiries for pumps, full information should be given—that is, quantity of water desired, head, including friction (or give actual elevation and length of suction and discharge piping), type of pump desired, how driven—whether belt, steam engine, electric motor (give electric current characteristics), arrangement of suction and discharge openings desired, whether right hand or left hand, etc.

DREDGING PUMPS

MORRIS Dredging Pumps are made in sizes from 2" discharge and upward, built of cast iron or cast steel, both lined and unlined. They are belt driven or direct connected to steam engines. For the sake of economy 15-inch and larger dredging pumps are usually directly connected to compound or triple expansion steam engines. We have also many dredging pumps in service directly connected to electric motors. We can furnish pumps only or the complete dredge, including all machinery.

253



20" HYDRAULIC DREDGE with 750 H.P. MORRIS Triple Expansion Engine, Water Tube Boilers, Cutter Machinery. This Size Dredge Has an Average Capacity of 250,000 Cubic Yards of Material per Month

STEAM ENGINES

We also build a very complete line of STATIONARY AND MARINE ENGINES, in single cylinder, compound and triple expansion types.

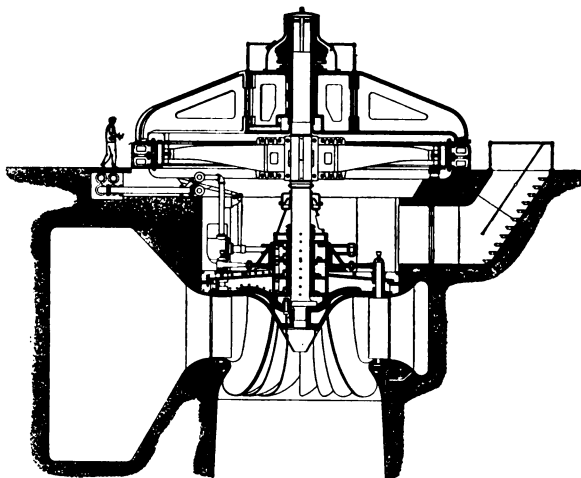


I. P. MORRIS COMPANY

HYDRAULIC DEPARTMENT

PHILADELPHIA, PA.

**SPECIALISTS IN THE DESIGN AND CONSTRUCTION OF HIGH CLASS,
HIGH POWER AND HIGH EFFICIENCY HYDRAULIC TURBINES**



LARGEST TURBINE EVER CONSTRUCTED

Cross section through 10,800 H.P. turbine in the plant of the Cedars Rapids Mfg. & Power Co., St. Lawrence River, Canada. The I. P. Morris Co. designed and built nine main units of this size, three exciter units, all the governors and the central pumping system.

Among the contracts for turbines of this type recently awarded to the I. P. Morris Company may be mentioned:

Appalachian Power Company,	New River, Va.	Station No. 2. 4—6,000 H.P. Turbines	Head 49 feet, Speed 116 R.P.M.
Mississippi River Power Company,	Keokuk, Iowa	Station No. 4. 3—3,500 H.P. Turbines	Head 34 feet, Speed 97 R.P.M.
J. G. Whitto & Co.,	Stevens Creek Development, Georgia	8—10,000 H.P. Turbines	Head 32 feet, Speed 57.7 R.P.M.
Alabama Power Company,	Coosa River, Alabama	5—3,125 H.P. Turbines	Head 27 feet, Speed 75 R.P.M.
Cedar Rapids Mfg. & Pr. Co.,	St. Lawrence River, Canada	4—17,500 H.P. Turbines	Head 68 feet, Speed 100 R.P.M.
Laurentide Company, Ltd.,	Grand Mere, P. Q., Canada	9—10,800 H.P. Turbines	Head 30 feet, Speed 55.6 R.P.M.
Northern Ontario Light & Power Co.,	Fountain Falls, Cobalt, Canada	3—1,500 H.P. Turbines	Head 30 feet, Speed 150 R.P.M.
Turner Falls Company,	Turner Falls, Mass.	6—20,000 H.P. Turbines	Head 76 feet, Speed 120 R.P.M.
Pennsylvania Water & Power Co.,	McCall Ferry, Pa.	2—1,500 H.P. Turbines	Head 30 feet, Speed 150 R.P.M.
Columbia Mills Co.,	Minetto, N. Y.	3—9,700 H.P. Turbines	Head 54 feet, Speed 97.3 R.P.M.
		1—16,500 H.P. Turbine	Head 63 feet, Speed 94 R.P.M.
		6—2,200 H.P. Turbines	Head 17.5 feet, Speed 68.2 R.P.M.

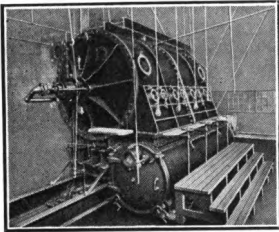
Total capacity of turbines built or under construction by I. P. Morris Company, 1,690,000 horse-power, of which turbines aggregating 485,900 horse-power are of the type illustrated above.



J. P. DEVINE COMPANY

BUFFALO, N. Y.

MANUFACTURERS OF VACUUM DRYING & EVAPORATING APPARATUS



Vacuum Drum Dryer

VACUUM DRUM DRYERS

For Dyewood and Tanning Extracts, Milk and Food Products, Pastes, etc.

A rapid and uniform drying is effected because the drum dips into the solution and takes up a thin film of the wet material of 1-125 of an inch and less. The water is evaporated from the material at a temperature of from 117° F. to 96° F. according to the Vacuum in the apparatus of $26\frac{3}{4}$ " to $28\frac{1}{4}$ ".

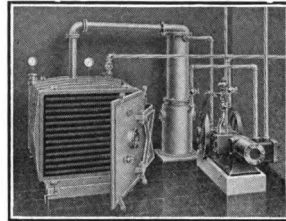
The drying process is continuous and independent of climatic conditions; free from dust and consequent elimination of danger to health of employees and destruction of property; and at a minimum cost of operation, including labor.

VACUUM CHAMBER DRYERS

For Colors, Dyes, Extracts, Salts, Rubber, Smokeless Powder and High Explosives, and other Chemical and Food Products.

The Vacuum Drying Chamber is designed to remove the water rapidly and at a low temperature from materials which cannot be dried by methods used heretofore without altering their chemical composition on account of their sensitiveness to heat. It may also be used with great saving in time, fuel, cost of plant, and working expenses for other substances where a low temperature is not an absolute necessity.

Materials which are difficult to dry in the atmosphere or which cannot be dried at all in the atmosphere without decomposition have all moisture removed from them in a very short time in the vacuum chamber without danger of impairing their qualities by overheating.



Cast-Iron Vacuum Drying Chamber with Surface Condenser and Vacuum Pump

VACUUM ROTARY DRYERS

For Starch, Granular Substances, and Chemical By-Products.

The moist material is conveyed by an elevator into a hopper high above the manhole to facilitate the charging of the apparatus. After charging, the manhole is closed and a high vacuum produced by means of an air pump, the vapors passing into the condenser.

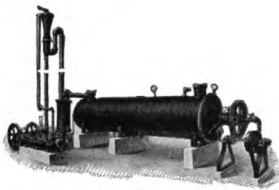
Concentric with the steam jacketed outside cylinder is a revolving inside drum, heated by live or exhaust steam, to which stirring blades are attached. The material to be dried is between the inside drum and the outside cylinder and is kept in constant motion by the stirring blades. Thus every particle comes into close contact periodically with the heating surfaces, and a very thorough and even drying process results.

VACUUM PUMPS of highest efficiency and of non-corrosive metals.

VACUUM PANS for any requirement and capacity in single or multiple effect.

CONDENSERS, AIR COMPRESSORS, AIR FILTERS, ETC.

Over 3,000 Installations in Daily Operation



Rotary Vacuum Drying Apparatus



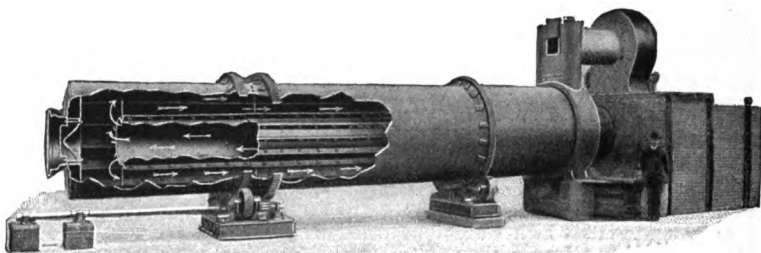
RUGGLES-COLES ENGINEERING CO.

50 CHURCH ST., NEW YORK CITY

McCormick Bldg., CHICAGO

CONSULTING ENGINEERS AND MANUFACTURERS OF DRYING MACHINERY

We build Ruggles-Coles "Double-Shell" Dryers for drying a large variety of inorganic and organic materials. As different materials require different kinds of treatment in drying, naturally no one type of apparatus can be adapted to all drying processes. We have designed, and now build, seven distinct types of machines. These cover the whole field of drying as completely as possible. For peculiar drying problems, we modify one of our regular type of dryers, or make special apparatus to suit requirements. With over sixteen years of experience in this line of work, together with the fact that we have installed over 500 machines, we are confident of being able to handle any problem in drying which may be submitted to us.



Section of Ruggles-Coles Dryer "Double-Shell" Showing Direction of Gases

Class "A" Dryer.—The principle of the Ruggles-Coles "Double-Shell" Dryer is that the material being dried passes the hot gases in the opposite direction to their travel. The Class "A" dryer consists of two concentric shells rigidly connected at the center. Between this point and each end are two sets of swinging arms allowing for unavoidable expansions and contractions. The inner cylinder at the head or feed end is connected with the furnace by a flue lined with fire brick. At the discharge end is a revolving head on the inside of which are lifting buckets so that the material is delivered out through the central casting.

The furnace is independent of the machine and located in a convenient place, although generally placed close to the head of the dryer. The heated air passes through the inner cylinder and returns between the outer and inner cylinders to the fan, passing on the way the material to be dried. By reason of the inclination and revolution of the dryer the material is carried to the discharge end.

This dryer is especially suitable for drying cement rock, clay, coal, ores, sand, gypsum, fullers earth, peat, sewage sludge, tankage, etc., etc.

Class "B" Dryer.—For materials which cannot be dried by direct heat on account of the danger from ignition or injury of the materials by furnace gases, we build a dryer similar in all respects to the Class "A" machine except the gases are taken from the inner flue and returned through a number of tubes, so that it does not come into direct contact with the material being dried.

Class "E" Dryer.—For drying nitrate of soda and other fusible salts which are not injured by direct heat but which cannot be dried in a rotary dryer, on account of the material adhering to the shell, we build a special dryer which has the advantage of direct heat with positive feed and delivery.

Class "F" Dryer.—When the quantity of material to be dried is small or the amount of moisture to be evaporated is slight, we build a dryer of single shell construction, and while not as economical in fuel cost as our Class "A" dryer is much lower in first cost.

SWENSON EVAPORATOR COMPANY

945 MONADNOCK BLDG., CHICAGO, ILL.

Cable Address—EVAPORATOR, CHICAGO

EVAPORATION ENGINEERS—MANUFACTURERS OF SINGLE AND MULTIPLE EFFECT EVAPORATORS, VACUUM PANS, BEET SUGAR MACHINERY, PAPER PULP MACHINERY, LEACHING BATTERIES, HEATERS AND SPECIAL APPARATUS for Removing Large Quantities of Water from Dilute Solutions

A MULTIPLE EFFECT EVAPORATOR offers the only economical way of removing large quantities of water with exhaust or live steam. The economy is inversely proportional to the number of effects, i.e., a triple effect will remove *three times* as much water with one pound of steam as can be boiled off in an open tank and also permits the use of exhaust (2-3 lb. pressure).

Our evaporators are handling practically every solution concentrated in commercial quantity, some of the products being in the following list:

Glue	Sugar	Potash	Black Liquor
Gelatine	Glucose	Caustic Soda	Nicotine
Glycerin	Steepwater	Iron Sulphate	Epsom Salts
Tankwater	Distillery Waste	Salt—Pepsin	Tomato Pulp
Beef Extract	Milk Sugar	Calcium Chloride	Tartaric Acid
Garbage Water	Malt Extract	Sodium Nitrate	Acetate of Lime

257

We build several types of evaporators among them being the following: 1. **Standard Swenson horizontal removable tube machines** for straight concentration—this type being used for most free boiling solutions; 2. **Patented basket type evaporators** for crystallizing solutions and for bad scaling materials; 3. **Standard vertical tube pans**; 4. **Special evaporators** made of lead, aluminum, bronze,—also with interior surfaces coated with some protective material that is acid resistant, such as cement, paint, tile or brick; 5. A special type,—semi-film, for **foamy liquors**; 6. A new type for working under high pressure for **high concentration**, etc.

Each of these designs has a particular field and our long experience in evaporator specialization has resulted in the accumulation of data that enables us to work out any problem.

Let us send you a partial list of our customers and explain why we are getting all the business from the **largest users** of evaporators some of whom have bought from **thirty to forty machines**. When writing, send as many details in connection with your work as you have available so we can submit blue prints, etc.

Largest builders of evaporators in the United States

Over 700 installations—20 years experience

Now shipping 50 machines each year

WILLIAMS PATENT CRUSHER AND PULVERIZER CO.

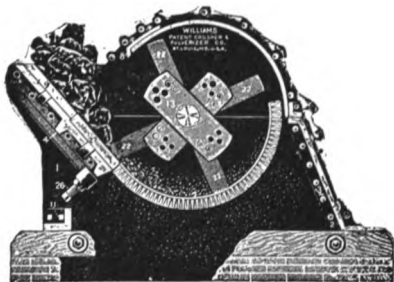
OLD COLONY BLDG., CHICAGO

WORKS
ST. LOUIS

BRANCH OFFICES
NEW YORK SAN FRANCISCO PHILADELPHIA PITTSBURGH

MANUFACTURERS OF CRUSHING AND GRINDING MACHINERY

COAL CRUSHERS FOR COKE OVEN WORK, BY-PRODUCT AND BEEHIVE OVENS



By the use of the Williams Patent Hammer Crushers with the various adjustable features, the following results are obtained from the ovens: The oven pulls easier, more coke is made from each oven, the ash is reduced, the coke comes out firm, regular in size, does not crumble, and the structure is much improved.

The substantial construction of these machines is plainly shown in this cut; all parts subject to wear are easily adjustable, which includes the hammers, the discs, the cage bars, and the breaker plates. The housing is entirely protected from wear by heavy liner plates made of heavy chilled iron. The machine is very accessible, as it is made of sectional construction.

SPECIFICATIONS REGULAR CRUSHER

Size Mill	Hopper Opening	Size Feed	Capacity Tons Per Hour			Speed	Size Pulley		Extreme Dimensions			Horse Power	W'ght
	In.		1/2" & finer	3/4" & finer	1" & finer	R. P. M.	Diam.	Face	L'gth	Width	H'ght		P'nds
1	15x12	Run of Mine	30-40	25-30	20-25	1000	20"	15"	6'	6'6"	3'9"	20-25	6500
2	20x12		45-55	40-50	30-40	1000	20"	15"	6'	7'6"	3'9"	30-35	7500
3	30x16		65-80	60-70	45-60	1000	20"	15"	6'	8'6"	3'9"	50-60	9500
4	40x18		100-115	80-90	60-80	1000	24"	18"	6'	9'0"	3'9"	75-80	10500
5	50x20		120-140	100-110	75-100	1000	24"	20"	6'	9'6"	3'9"	100	12000
6	60x20		150-175	115-130	100-120	1000	24"	22"	6'	11'0"	3'9"	125	13500

JUMBO SPECIFICATIONS

5	30x24	R.O.M.	150-175	120-140	80-100	750	24"	18"	8'10"	9'	5'4"	85-100	20000
6	36x24		180-200	145-165	120-140	750	30"	20"	8'10"	10'	5'4"	140-150	24000
7	48x30		225-250	200-220	150-175	750	30"	24"	8'10"	11'	5'4"	165-185	28000
8	60x30		275-300	250-275	180-200	750	30"	24"	8'10"	13'	5'4"	200-250	30000

CRUSHERS FOR ANTHRACITE MINE REFUSE

Our Patent Hinged Hammer Debris Crushers are in extensive use for properly crushing and treating Anthracite debris or Culm before flushing it into the mines.

CRUSHERS FOR CHAIN GRATES OR STOKERS

The Williams Patent Coal Splitter takes Run of Mine Coal and reduces the same to 1 1/2", 1 1/4", 1", 3/4" and finer with the "minimum amount of fine dust," the only machine made that can be regulated to properly size coal. All parts are adjustable to wear; the crusher is also adjustable to give most any size coal desired.

BRIEF SPECIFICATIONS

No. of Crusher	Hopper Opening, Inches	Weight	Horse Power	Capacity—Tons Per Hour R.O.M. to 1 1/2" and Finer
1	15x12	6,500	15 to 20	25 to 40
2	20x12	7,200	20 to 25	50 to 60
3	30x16	9,500	40 to 50	75 to 100
4	40x18	10,500	60 to 75	100 to 125
5	50x20	12,000	85 to 100	135 to 175
6	60x20	13,500	100 to 125	180 to 220

We also crush Coal and Pitch for Briquette Plants—for Coal Washers, before and after washing, and make a specialty of sizing Coal for all Commercial Purposes.

WILLIAMS PATENT CRUSHER AND PULVERIZER CO.

RAW MATERIAL GRINDERS FOR CEMENT AND GYPSUM PLANTS

UNIVERSAL MILL

This *Universal Grinder* is the *only* machine of its kind made. Will take DRY 2" Limestone, Shale, Clay, or Coal, and deliver at one operation a product 95% through 20 mesh, TUBE MILL FEED WITHOUT OUTSIDE SCREENS OR SEPARATORS. *No other machine* can deliver the fine uniform product year in and out.



COMPLETE SPECIFICATIONS UNIVERSAL MILLS

Size Mill	Size Feed	Diam. Mill	Capacity Per Hour Stone		Speed R. P. M.	Horse Power	Floor Space Extreme Dimensions			Size Pulley		W'ght P'nds
			12 Mesh	20 Mesh			L'gth	Width	Height	Diam.	Face	
0	1 "	18"	3/4	1 1/2	1800	10-12	5'	5' 1"	3' 2"	8"	8 1/2"	2500
1	1 1/2 "	26"	2-4	1-3	1600	15-20	6' 3"	5' 10"	3' 8"	16"	10 1/2"	4000
2	1 1/2 "	26"	5-6	3-5	1600	20-25	6' 3"	6' 3"	3' 8"	16"	12 1/2"	5000
2xx	2 "	26"	6-8	5-6	1600	30-35	6' 3"	7'	3' 8"	20"	15 "	6500
3	2 "	40"	10-12	8-10	1100	50-60	7' 6"	6' 10"	5' 4"	20"	15 "	12000
4	2 1/2 "	40"	13-15	10-13	1100	65-75	7' 6"	7' 10"	5' 4"	20"	18 "	14000
5	2 1/2 "	40"	16-20	15-18	1100	80-100	7' 6"	8' 6"	5' 4"	20"	20 "	16500
9	3 "	60"	25-35	20-30	750	150-175	12'	9' 2"	7' 2"	30"	24 "	30000

VULCANITE RE-CRUSHER

These Vulcanite grinders will take raw material, limestone, shale, clay or coal, in cubes of 3 inches and under, and reduce the same to 1/2 inch or 1/4 inch. This makes an excellent feed for those plants which use roller mills as finishers in the raw end.

VULCANITE SPECIFICATIONS

Size Mill	Hopper Opening	Size Feed	Capacity Tons per Hour			Speed R. P. M.	Horse Power	Extreme Dimensions			Size Pulley		W'ght P'nds
			1/2"	3/8"	1/4"			L'gth	Width	Height	Diam.	Face	
1	14"x 5"	1 1/2"	4	3	2	1500	15-18	4' 8"	6' 3"	3' 3"	16"	10 1/2"	4200
2	18"x 6"	2 "	7	5	3	1500	20-25	4' 8"	6' 6"	3' 3"	16"	12 1/2"	5000
2xx	24"x 6"	2 "	10	8	6	1500	30-35	4' 8"	7'	3' 3"	20"	15 "	6000
3	18"x 8"	2 1/2"	20	18	15	1000	40-50	5' 2"	7'	4'	20"	15 "	10000
4	24"x 8"	3 "	30	27	25	1000	70-75	5' 2"	7' 4"	4'	20"	18 "	12000
5	30"x 8"	3 "	35	30	28	1000	90-100	5' 2"	8'	4'	20"	20 "	14000
6	36"x 10"	3 "	40	35	30	1000	110-125	5' 2"	9'	4'	20"	22 "	15500
7	40"x 10"	3 "	50	42	35	1000	125-150	5' 2"	9' 6"	4'	22"	24 "	17500

We issue the following catalogs:

Coal Crusher Catalog—For all those crushing and grinding coal, etc.

Cement and Limestone Catalog—Limestone, Gypsum and Similar Grinders.

Fertilizer Catalog—Bone, Tankage, Shells and Fertilizer Work.

Clay Catalog—Clay, Shale, etc., for Brick, Tile and Terra Cotta.

Oil Cake Catalog—Linseed, Cottonseed and Similar Oil Cake Grinders.

Shredder Catalog—Bark, Chips, Cork and all Fibrous Materials.

Stock Food Catalog—All Cereals for Feed Millers, Alfalfa, etc.

Mention material you wish to crush or grind and we shall see that you receive the proper catalog and specifications.

L. O. KOVEN & BROTHER

OFFICE—50 Cliff Street, New York City

FACTORY—JERSEY CITY, N. J.

**ENGINEERS, MANUFACTURERS, MACHINISTS AND DESIGNERS.
FABRICATED PLATE STEEL, COPPER, BRASS, TIN, ALUMINUM,
ETC., OF ANY SHAPE. DESIGNERS OF SPECIAL APPARATUS FOR
MANUFACTURING INDUSTRIES**

We are prepared to do plate work of every description for Ships, Mills, Mines, Factories, Plantations, Chemical Works, Paint Works, Paper Mills, Abattoirs, Fertilizer Plants, Water Works, Government Work, Sewage Systems, etc. We also make and design Special Apparatus and Machinery to meet the progress in all lines of business. *We have the facilities for improving yours.*

A Partial List of What We Make

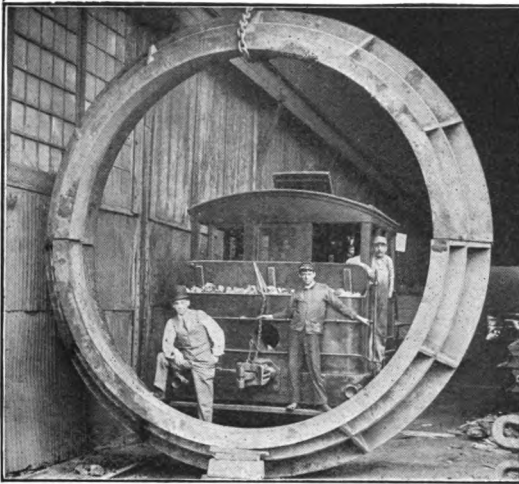
Autoclaves	Kilns
Bottle Sterilizers	Lead Lined Tanks
• Bread Racks	Malt Tanks
Can Washers	Metal Melting Furnaces
Canned Goods Sterilizers	Mixers
Cheese Vats	Mufflers
China Kilns	Oil Filters
Coil Boilers	Oyster Washers
Condensed Milk Coolers	Percolators
Copper Tanks	Pie Racks
Copper Lined Steel Tanks	Pipe (Riveted)
Creosoting Tanks	Plating Tanks
Drying Apparatus	Sand Blast Tanks
Exhaust Manifolds	Sprayers, Fruit Tree
Extractors	Sprayers, Paint
Galvanized Tanks	Steam Kettles
Gasoline Tanks	Sterilizers
Gasometers	Still
Glass Kilns	Smoke Stacks
Glue Dissolvers	Tanks (Air, Gas, Oil and Water)
Gum Washers	Tumblers
Ham Boilers	Vacuum Pans
Hot Water Tanks	Varnish Tanks
Humidifiers	Vulcanizers
Jacketed Tanks	Water Stills

THE MARSHALL FOUNDRY CO.

28TH AND RAILROAD STS., PITTSBURGH, PA.

INGOT MOLDS AND GREY IRON CASTINGS

Capacity 250 tons per day.



INGOT MOLDS
made from remelted standard Bessemer pig iron.

GREY IRON CASTINGS
for all purposes—10 lbs. to 40,000 lbs.

STRUCTURAL CAST IRON
Columns, Bases, Treads, Sills, Lintels, Guards, Floor Plates, Trench Plates.

HEAVY STONE CRUSHING CASTINGS

We make a specialty of **LARGE CASTINGS** such as:—**OPEN HEARTH, BESSEMER STEEL WORKS and BLAST FURNACE CASTINGS,**
BELLS HOPPERS EXTENSIONS TROUGHS
HEARTH JACKETS COOLING PLATES
FURNACE RUNNERS BLOW PIPES COLUMNS
SOAKING PIT COVERS, SOAKING PIT and INGOT CARS
CINDER and SLAG POTS, LADLES, THIMBLES,
LININGS; also TINNING POTS.
AIR AND GAS VALVES GAS PRODUCERS

SPECIAL CASTINGS CONDENSERS PIPE SECTIONS
SPECIAL EXHAUST OUTLETS SCREENS
CHEMICAL POTS and KETTLES, STILLs, PANS, etc.,
for
CHEMICAL, SOAP, GLYCERINE, SUGAR, PAINT, VARNISH
and BY-PRODUCT COKE WORKS.

INGOT MOLDS—SOLID OR SPLIT

All kinds and sizes, for Bessemer, Open Hearth, or Crucible Steel.

We have on hand **PATTERNS and EQUIPMENT** for all sizes of **MOLDS** used in general mill work.

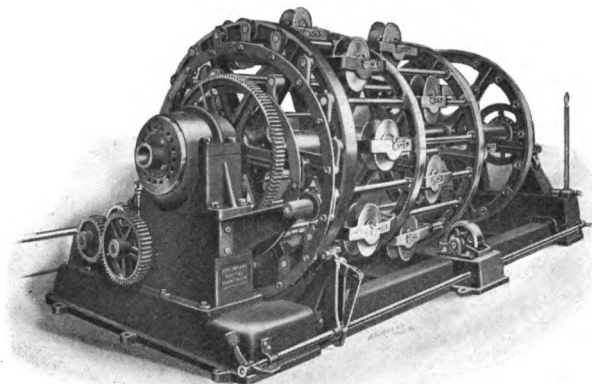
NEW ENGLAND BUTT COMPANY

PROVIDENCE, R. I.

European Agents: Selson Engineering Company, Ltd., London, England

MANUFACTURERS OF BRAIDING MACHINERY; MACHINERY FOR INSULATING WIRES AND CABLES, ALSO MACHINERY FOR THE MANUFACTURE OF WIRE ROPES AND CABLES.

CABLING AND STRANDING MACHINERY



24 Reel Horizontal Cabling Machine

These machines are used for the manufacture of wire ropes and also in making electrical conductors. They are built in all sizes and in various types for different purposes.

BRAIDING MACHINERY

American and German Type

Used for making plain and fancy braids for dress trimmings and millinery, round and flat shoe laces, soutache braids, candle wicking, tapes, cords, banding, clothes lines, fish lines, packing, gas tubing and rubber hose, round and flat elastic.

Sash Cord Braiders for making solid sash and curtain cord of various sizes.

Sash Cord Finishers for polishing solid sash cord.

Silk Covering Machines for covering cotton with silk.

Braid Spooling and Measuring Machines.

Rubber Spreading Machines, built of any desired width for applying a thin coating of rubber to cloth.

INSULATING MACHINERY

Single, Double and Triple Deck Braiders

These are made in all sizes and combinations for covering wires from small sizes up to large cables.

Magnet Wire Machinery for Silk and cotton covering arranged to handle round and flat wires.

Annunciator Wire Winders, Single, Double or Triple Deck.

Taping Machinery for taping wires or cables with paper or other materials.

Polishing Machines, for insulated wires and cables from the small sizes up to 3" cables.

Wire Measuring Machines.

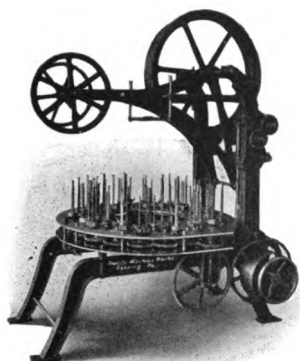
Twinning Machines.

Rubber Strip Covering Machines, for applying rubber insulation to wires and cables with either single or double seam. These machines are built in several sizes and handle from one up to twenty wires at a time.

TEXTILE MACHINE WORKS

READING, PA.

MANUFACTURERS OF BRAIDING AND INSULATING MACHINERY



Rubber Hose Braider

High Grade

BRAIDING MACHINES

for

Electrical Wires and Cables

and for making and armoring

Rubber Hose

Packing Braiders

Magnet Wire Machines

Take up Fixtures

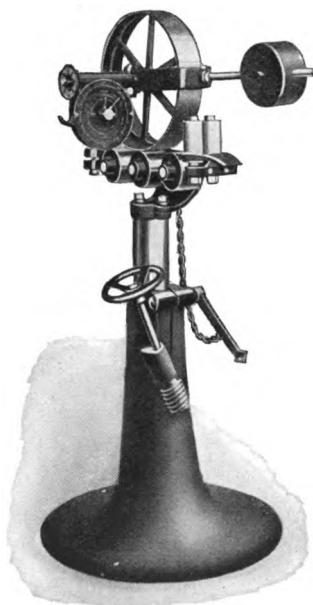
Annunciator Wire Winders

Rubber Strip Covering Machines

Winders and Doublers

Measuring Machines

Etc.



**Measuring Machine for
Wires and Cables**

HIGH GRADE GRAY IRON CASTINGS

THE H. B. SMITH CO.

WESTFIELD, MASS.

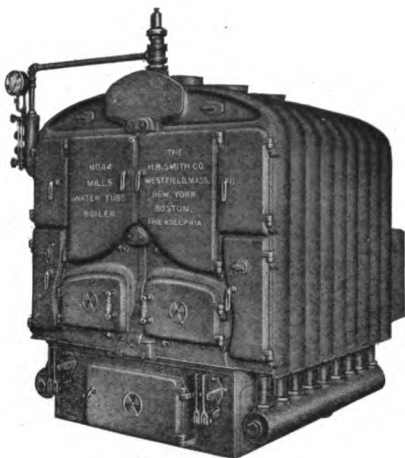
NEW YORK: 39 East Houston Street

BOSTON: 138 Washington Street North

PHILADELPHIA: 1225 Arch Street

BOILERS AND RADIATORS FOR STEAM AND WATER WARMING

MILLS WATER TUBE BOILERS



No. 44 Steam Boiler

Vertical Water Tubes.

Vertical Fire Travel.

Tested to 125 lbs. at Works.

Rapid Circulation.

Dry Steam.

Economy of Fuel.



No. 24 Boiler

Width of Fire Pot 24 inches.

Rated capacity { Steam 900 ft.
to 2025 ft.
Water 1500 to
3350 ft.

No. 34 Boiler

Width of Fire Pot 34 inches.

Rated capacity { Steam 2000 ft.
to 5200 ft.
Water 3300 ft.
to 8575 ft.

No. 44 Boiler

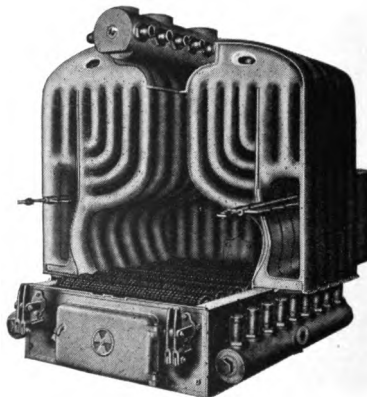
Width of Fire Pot 44 inches.

Rated capacity { Steam 3600 ft.
to 9000 ft.
Water 5950 ft.
to 14,850 ft.

No. 48 Boiler

Width of Fire Pot 48 inches.

Rated capacity { Steam 4800 ft.
to 12,000 ft.
Water 7925 ft.
to 19,800 ft.



No. 44 Boiler—Interior

THE H. B. SMITH CO.

PRINCESS DIRECT RADIATORS



Single
Column



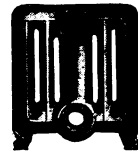
Two
Column



Three
Column



Five
Column



Five Column
Window Height

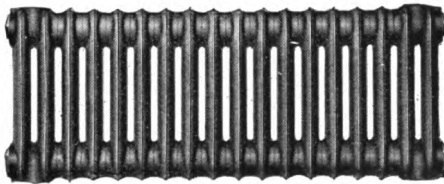
Malleable Iron Push Nipple connection between Sections.

Test at Factory { Two tests 100 lbs. water.
One test 80 lbs. steam.

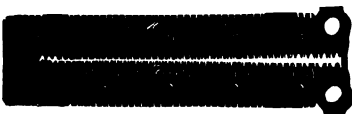
One and two column Radiators, Sections 3" on centers.

Three and five column Radiators, Sections 3 1/4" on centers.

265



PRINCESS
WALL
RADIATORS



Flange Surface

Indirect Radiators
FLANGE AND PIN EXTENDED
SURFACE
for
STEAM AND WATER WARMING

THE DORR CYANIDE MACHINERY CO.

FIRST NATIONAL BANK BUILDING

DENVER, COLORADO

17 Battery Place, New York City

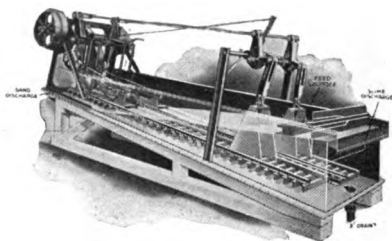
17 South Street, LONDON, ENGLAND

THE DORR CLASSIFIER, WASHER OR DESLIMER

THE DORR THICKENER or DEWATERER THE DORR AGITATOR or MIXER

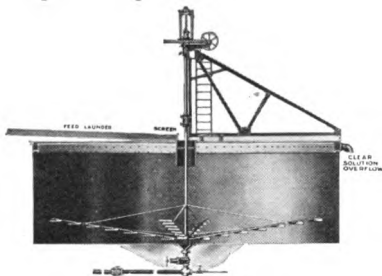
These machines were originally developed to meet specific needs in the process of cyaniding ores, but have since found wide application in industrial processes. They are characterized by sound engineering construction.

THE DORR CLASSIFIER affords the simplest means of making a practically perfect separation of sandy and slimy materials in a liquid pulp. Reciprocating rakes moving over an inclined surface elevate settled sand while suspended slime overflows a weir. The machine is adaptable to a wide range of uses. The cost of operation and maintenance is extremely low and the power requirement inconsiderable.



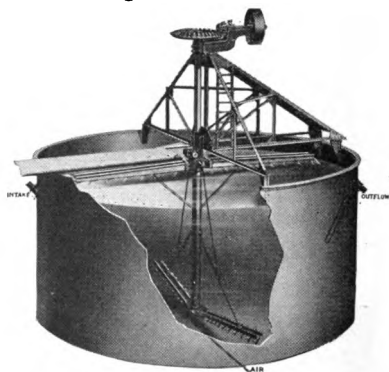
The Dorr Classifier—Patented

THE DORR THICKENER accelerates the settlement of finely divided solids suspended in any quantity of liquid. Clear liquid overflows at the periphery of the tank and thickened pulp issues continuously from the bottom. These machines are particularly useful in any process of continuous counter-current washing, avoiding excessive dilution and dispensing with filters. They offer great advantages over devices for intermittent settling or thickening.



The Dorr Thickener—Patented

THE DORR AGITATOR embodies features which overcome the great objection to other types of agitators, viz., the building up of solids within the tank. This is prevented by rotating rakes which move settled material to the central air-lift where it is elevated and again distributed over the surface through rotating launders. The machine is readily adapted to continuous agitation through a series of tanks. Coarse solids of high specific gravity are easily handled, and no difficulty is experienced in restarting after prolonged shut-down. Operating cost, both for air and power, is lower than that of any other agitator.



The Dorr Agitator—Patented

Acid-proof construction if desired.

Catalog and Engineering Data on Request.

**CATALOGUE SECTION
PART V**

**Measuring and Testing
Apparatus**

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Pages 269-300

INTRODUCTION

In speaking of engineering conditions as they existed in this country shortly after the close of the Civil War, Charles D. Porter, the inventor of the centrifugal governor and the high speed engine, tells us that "at that time almost everything in machine shops was done in the old fashioned way and accuracy depended entirely on the skill of the workman. The tool work left much to be done by the fitter. Interchangeability was unknown even in screw threads." Mr. Porter goes on to say that he personally "adopted the rule that in mechanical work there was only one way to insure that everything should always be done right, and that was to make it impossible that it should be done wrong." And that meant the use of gages, working to close fits, and extensive application of measuring apparatus.

This was not an easy thing for the early American engineer to do. Measuring instruments either were unknown at all or, on account of the high price of imports, practically inaccessible to American engineers. Such instruments as there were had to be imported from England. It is curious to find, for example, that Porter had been working for years on steam engineering, and had sold a large number of his governors, but as he confesses, only after several years of work did he or his designer Richards ever see an indicator, and he adds by way of explanation that "indicators were then but little known in this country."

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It was the manufacture of interchangeable parts, especially in connection with the production of fire-arms and sewing machines that necessitated at first the use of such elementary apparatus as gages. As regards what might be called higher class measuring apparatus, that is apparatus measuring physical quantities not directly measurable by the eye (thermometers, pyrometers, indicators, pressure gages, etc.) the demand for them was then naturally fairly low. The only prime mover of importance was the reciprocating steam engine, and the inability of replacing it by something else made a close study of its performances a rather useless proceeding, since, whether it was found efficient or not, there was nothing else to do but accept it as it was. In this connection we have a significant statement made by Professor William Kent at the time of the Centennial Exposition in Philadelphia.

After plotting the results of the boiler tests made there, Prof. Kent made the remark that the upper boundary represented

the highest results that could be expected, when every condition was most favorable, and the breadth of the field (and it was very broad) represented the depth of our ignorance as to what were the best conditions and how they might be obtained. Prof. Kent adds that at the time there was no apparatus for analyzing the flue gases, and *no one knew just what composition of gas was coincident with the highest efficiency.*

It was the rise of electric lighting that gave the first impetus toward a closer study of the performances of the steam engine. Electrical engineering, partly because it was taken up in a more scientific spirit and also because of its very nature, required working to close limits. Electrical incandescent lamps burn efficiently only at certain voltages and a variation in voltage within a few per cent will either cause a material falling off in the amount of light or will shorten the life of the filament. Under these conditions it was natural that voltmeters, ammeters and other measuring apparatus early became an indispensable part of the outfitting of central stations. The early appearance of several types of electrical generators made it also necessary, for purposes of selection, to investigate thoroughly their efficiency and to obtain reliable records of their performances. In this way in the early eighties the central station men had a very clear idea of what was going on at the electrical end of their plants, and it was but natural that they should turn their attention to the source of power generation and want to know with similar clearness how the steam end of the plant, the engine, boiler and furnace, were behaving. This led to a rapid development of measuring instruments and their wider introduction in commercial plants.

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The last 20 years have seen another development of the highest importance in the field of mechanical engineering. Some twenty years ago, as has been said above, the steam engine was practically the only source of power generation by the application of heat. Now, however, we have in addition to it the steam turbine, the gas producer engine, the gas engine working on city gas, the coke oven and blast furnace gas engine, the Diesel and semi-Diesel engines, the gasoline engine, and one or two more types of prime movers which have not yet attained the stage of commercial application, such as the Fullagar engine, the gas turbine and the rotary steam engine. Therefore with the number of types from which a selection can be made as wide as at present, the designer of a power plant must know very exactly what the efficiency and performances of each type are in order to select the type most appropriate to the given conditions of operation, and the kind of work to be performed. A good deal has been said during the last few years about efficiency in power plants. It seems clear, however, that it would not be a

proper comprehension of the principles of efficiency to save pennies by stop-watching the movements of the employees, and at the same time allow dollars to run away at the coal pile by the adoption of unsuitable equipment or use of deficient machinery. With the present conditions of competition a man who wants to succeed must know exactly what he is doing, and if he is not familiar with the kind of measuring instruments which would tell him the conditions in his plant, he may be sure of getting into trouble sooner or later.

Going back to the interesting *Reminiscences* of Charles D. Porter, showing the engineering conditions in this country in the sixties and seventies, we find there a rather significant indication. The Richards Indicator was invented by an American and initially made in this country. But it was an English firm, the Elliott Bros., who developed it and created enormous sales both in England and abroad. For many years the English practically controlled the market for measuring instruments, even though several important instruments had been invented and designed by American engineers. Within the last 20 or 25 years, however, an extensive industry in the manufacturing of measuring instruments has been developed in this country; so that now not only the American market can be fully supplied by its own output but a good many instruments made in this country have found an extensive application in Europe, where users are attracted by the comparative ruggedness and fool-proofness of the American instruments, primarily intended to be used not so much by trained engineers as by the ordinary class of help found in the shops of this country. It may be therefore safely stated that at the present time the American market is entirely independent of the European instrument makers, with the exception perhaps of some classes of instruments for the finest measurements, chiefly measurements in the higher branches of scientific investigations. However, as regards commercial measurements and such measurements as are required by current engineering practice, the user, if he investigates the market properly, will find that American makers can not only supply him with instruments as cheap as and sometimes cheaper than, the imported types, but that almost invariably the American instruments will be found to be better adapted to local conditions.

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While more and more plants are beginning to rely on precise measurements rather than on pure guess-work, one has unfortunately to recognize that the use of measuring instruments is not by far as extensive as it ought to be. There still prevails to a certain extent the idea that an investment in an instrument which will tell exactly what can be told approximately by touch or by guess, hardly pays for itself. That this idea is wrong, many have already found out to their sorrow. The only way to insure that everything

shall always be done right is to make it impossible that it shall be done wrong. The human element in mechanical work must be eliminated as much as possible. Even if the engineer can rely on himself to maintain a certain process at a required temperature, to keep the draft at a certain height, or to keep his engine running in a certain way, he can never be sure that the same will be done while he is away from the plant; or if he believes that he has a foreman or a substitute as efficient as he is, a very brief calculation will show that in order to keep such a reliable and efficient subordinate, he has to pay him extra a good deal more than a reasonable interest on an investment in such measuring and recording instruments as would absolutely insure the plant running in the desired manner.

In one of Kipling's stories, a miller installs electric light in an old fashioned water mill, and when the light is turned on, he suddenly discovers that he never really knew what his mill was like. He finds dirt and cobwebs in places where he never expected to see them, and, to top his surprise, he finds his cat in a friendly conversation with the mice. As a result, the cat is thrown into the mill flow, and things begin to happen. Barring such poetical exaggerations as are natural in an allegorical tale, what Kipling describes is, to a large extent, true of a good many industrial plants. No precise measurements of their output or performances have ever been taken and the owner or operator but seldom knows how much his work actually costs him and whether there are not some leaks which could be easily repaired had he but known of their existence.

What seems to be the trouble in a good many cases is that the operators of mechanical plants either do not know yet of the existence of measuring apparatus which might help them to get a better insight into what is going on in their plants, or are unfamiliar with the application of the existing apparatus to their particular needs.

It might be mentioned in this connection that the production of measuring instruments is a branch of engineering requiring from its personnel some of the highest qualifications that an engineer can possess. The measuring instruments must be moderate in price or they would not find a sufficiently wide market. They must stand a good deal of rough handling, sometimes at the hands of people not properly familiar with their application; unless an instrument is strong enough and foolproof enough to be used under ordinary shop conditions and by the ordinary help available, it would soon be found that the number of its users were rapidly dwindling to a minimum. Then the apparatus must be built to maintain reasonable accuracy during a long period. All this requires a thorough knowledge of the materials employed in the construction and of principles of design of the instrument, so as to produce at a moderate cost a thoroughly reliable, accurate and reasonably strong

piece of apparatus. It is natural that the highest engineering skill has to be applied to attain this difficult end. In addition to that the apparatus must be thoroughly adapted for use in the plants of its prospective purchasers which presumes a considerable degree of familiarity with the operation and conditions in various classes of engineering plants. In other words, the instrument maker must not only thoroughly understand how to build the instrument but he must also possess an equally thorough familiarity with the field in which his instruments may be used.

This leads one to believe that a good deal of benefit might be derived from a closer co-operation between the user and the instrument maker. The former ought to consider the concerns manufacturing instruments as a sort of bureau of consulting engineers always at his service; and he should from time to time put up to them his problems and let them help him to find out whether there are not some leaks in his plant that might be stopped, or some antiquated methods in processes of production, etc. The instrument maker could sometimes, by suggesting a proper measuring and recording apparatus, help a manufacturer or engineer to avoid losses which may run into thousands of dollars. There is no reflection on the ability of an operating engineer asking a concern manufacturing measuring and testing apparatus what they could suggest to take care of some particular situation. The really efficient engineer is the man who not only knows thoroughly his own line of business, but is able to get the best information upon other lines of engineering work of use to him in handling his particular problems. There is not a single man alive who could honestly consider himself an expert in every branch of engineering, therefore, if an engineer asks for advice from a concern specializing in a certain line, and then uses this advice in the light of his own knowledge and experience, he is only taking the best care of the interests entrusted to him. A closer co-operation between the engineer or manufacturer and the instrument maker will, it is believed, rapidly lead to an introduction of that highest efficiency which is at the basis of the whole profession of engineering.

AUTOMATIC WEIGHING MACHINE CO.

MAIN OFFICE AND FACTORY

134-140 COMMERCE STREET, NEWARK, N. J.

AGENCIES

311 River St.
CHICAGO, ILL.

1045 Walnut Ave.
CLEVELAND, OHIO
Cable Address:—AWMCO

436 Pierce Bldg.
ST. LOUIS, MO.

MANUFACTURERS OF AUTOMATIC MACHINERY FOR WEIGHING, PACKING, SEALING AND CONVEYING RAW & MANUFACTURED PRODUCTS

To Engineers: We have a line of automatic weighing, packing and conveying machinery unequalled for *speed, accuracy, and durability*. Nothing would please us better than an opportunity to show you the direct and simple technical devices by which we secure both precision and continuous uninterrupted performance.

To Manufacturers: Ask us what can be done in the way of automatically handling your materials, raw or in manufacturing process, and after examination we will submit proposals that take advantage of all favorable conditions.

AUTOMATIC WEIGHING, PACKING AND SEALING MACHINERY

Adapted to the Use of Manufacturers and Packers of Sugar, Coffee, Spice, Snuff, Washing Powder, Baking Powder, Starch, Seeds, Cereals, Grains, Flour, Wheat, Rolled Oats, Salt, Fertilizers, Cotton Seed, Cotton Seed Meal, Rock and Shale, Clinker and Gypsum, Chemicals, Coal, Etc.

We outline a portion of our products in the following:

Mill, Elevator and Brewery Automatic Grain Scales—These machines belong to the type of "Net Weight" Scales, and are used for grains and all free flowing materials. Made in various sizes, adapted to the work required. Speed, 4 to 10 weighings per min.

Fertilizer Weighing Machine—Weighs directly into the sack. Designed to handle materials such as Raw Sugar, sticky Fertilizers, etc. Equipped with a self-contained feed. Capacity 50 to 200 lbs. Speed 3 bags and upward per min.

Small Package Automatic Scale—For whole Coffee, Hominy, Rice, Split Peas, Farina, Wheat, etc. Speed 20 to 25—1 lb. discharge per min. Capacity from 10 ounces to 2½ lbs.

Net Weight Automatic Scales—Material is weighed in the scale bucket and then discharged into a receptacle. This is the only true method of securing the actual desired weight of material, as all receptacles, whether of tin or cardboard, vary considerably in weight.

Sealing Machines—For automatic sealing of cartons. *Special features:* Most economical disposition of floor space, entire absence of air and steam lines, shortest time consumption when changing from one size carton to another, entire absence of rapidly moving parts, all flaps folded when stationary.

Guaranteed to seal 25 to 30 tight packages per minute. The complete outfit consists of a bottom sealer and a top sealer, connected with a suitable conveyor.

Coal Automatic Scales—Made in various sizes corresponding to work.

Clinker Automatic Scales—Designed especially for the handling of Clinker.

Clinker and Gypsum Automatic Tandem Scales—Provide means for adding exactly the required amount of Gypsum to Clinker in the making of Portland Cement. Clinker Machine will weigh from 190 to 400 lbs. and the Gypsum scale from 5 to 15 lbs.

Rock and Clay Automatic Tandem Scales—Primarily designed for weighing raw materials used in the manufacture of cement. Can be used for any materials that need proportioning for a mix. Made in all sizes and so connected together that each waits until the other has received the designated quantity, when they dump together. These machines have been installed in gangs of two or three. The Power Trip used is the most positive trip on the market.

RICHARDSON SCALE COMPANY

PASSAIC, N. J.

BRANCH OFFICES:

NEW YORK CHICAGO, ILL. WICHITA, KANS. BUFFALO, N. Y. ATLANTA, GA.
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AUTOMATIC WEIGHING MACHINERY

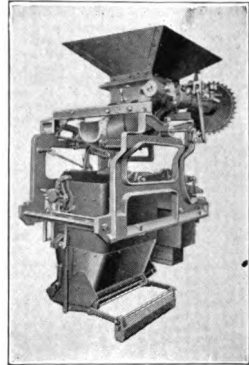
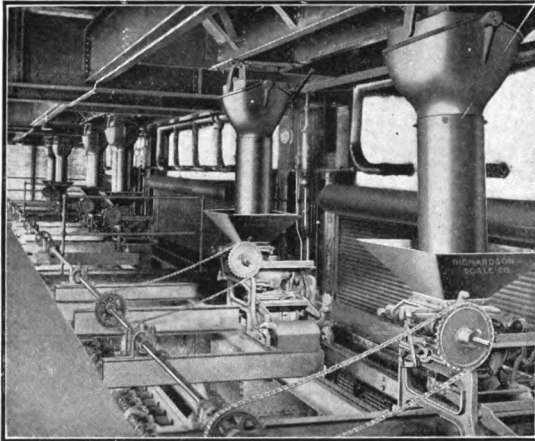
AUTOMATIC SCALES FOR POWER PLANTS

Scales weigh fuel direct to Boilers or discharge on Boiler Room Floor.

Automatically and continuously weighing and registering every pound of coal passing over them.

Weigh within an average accuracy of $\frac{1}{2}$ of 1%.

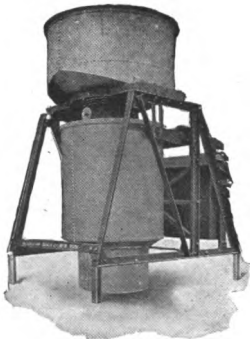
Made in sizes from 100 lbs. to 3000 lbs. per discharge.



Gravity Operated Boiler House Scale

Illustration showing installation of six of the twelve Richardson Automatic Scales weighing coal to Boilers at the Power Plant of the CONSOLIDATED GAS, ELECTRIC LIGHT & POWER CO., BALTIMORE, MD.

Scales for Weighing the coal as it is Received—placing a check on dealers weights.



Automatic Feed Water Scale

THE RICHARDSON AUTOMATIC FEED WATER SCALE

will accurately weigh, indicate and record boiler feed water or condensate.

Gives number of pounds of water evaporated per pounds of coal fired per horse power hour, or per Kilowatt hour.

EVEN ARM BEAM PRINCIPLE

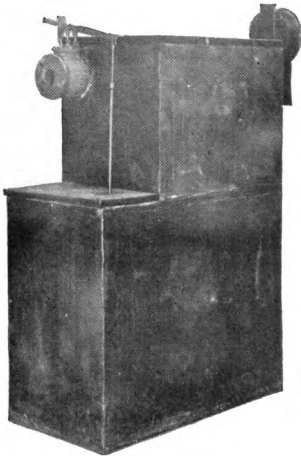
Standard Government Weights, balancing against materials to be weighed.

General Sales Agents for MERRICK CONVEYOR WEIGHTOMETER—Weighing Coal in transit over a bucket, belt or pan conveyor.

WILLCOX ENGINEERING CO.

SAGINAW, MICHIGAN, U. S. A.

THE WILLCOX WATER WEIGHER



Willcox Rectangular Water Weigher with Storage Tank and Automatic Chart Recorder

The WILLCOX WATER WEIGHER is a device for **automatically weighing and recording** the water fed to boilers. It takes water from any source, such as a feed water heater, tank, pump, or hydrant, at any rate of flow or at varying rates, and delivers it intermittently in charges of uniform weight.

It will weigh hot feed water from an open heater, cold water from a hydrant, water of condensation from vacuum pans or heating systems, also chemicals, volatile oils, sugar juices, etc.

Operation: The charge is weighed by a liquid column of fixed height, through the medium of an air balance. The unit charge is dumped automatically by the sudden release of the entrapped air—an extremely accurate method of balancing.

Accuracy: Each weigher is guaranteed to weigh within one per cent. of perfect accuracy at any rate of supply up to its maximum capacity.

Styles and Capacities: The Willcox Water Weigher is built in several styles to suit various requirements: portable weigher for evaporative and condensing tests, and power plant sets for permanent installation. All capacities from one

thousand pounds per hour up to half a million pounds.

Plans for Installation: Suggestions, sketches and plans for proposed installations are furnished free of charge by the Willcox Engineering Company. We have competent engineers and draftsmen for the purpose of assisting prospective customers in planning suitable arrangements to meet local conditions.

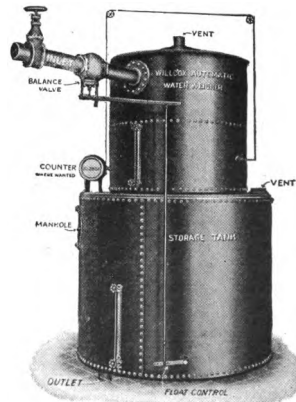
Savings Secured in Boiler Plants: By furnishing a simple, reliable, automatic self-recording device for continuously and accurately recording every pound of water pumped to the boilers, the Willcox Water Weigher offers a means of segregating boiler evaporation cost from engine and generator performance, thereby giving a sure means of determining from day to day whether or not a proper evaporation is being secured per pound of coal.

GENERAL DIMENSIONS—STYLE A BUILT OF BOILER PLATE

Size No.	Maximum rate of weighing, in lbs. of water per hour	Size Inlet, In.	Shell, Thickness	APPROXIMATE	
				Ship'g Weight	Weight of water per unit charge
1	500,000	10	3/8	4000	5000
3	300,000	8	5/16	3000	3500
5	200,000	6	1/4	2100	2700
7	150,000	6	1/4	1850	2250
9	100,000	6	3/16	1500	1800
11	75,000	4	3/16	1200	1100
12	62,500	4	3/16	1100	1180

STYLE B—INGOT IRON

14	40,000	3	....	600	680
16	25,000	2½	....	400	420
18	15,000	2	....	275	200
20	10,000	2	....	175	120
22	5,000	1½	....	150	60



The Willcox Automatic Water Weigher with Storage Tank. Style A

Send for Water Weigher Catalogue W-8

GAMON METER COMPANY

MAIN OFFICE AND WORKS

282-296 SOUTH ST., NEWARK, N. J.

MANUFACTURERS OF WATER METERS

"WATCH DOG" WATER METERS

The "Watch Dog" Meter is a successful effort to increase the range and efficiency of disk and current water meters. It is built to render a superior service at a nominal cost and its ACCURACY, DURABILITY, SIMPLICITY, ACCESSIBILITY, INTERCHANGEABILITY and FROST GUARANTEE are not to be surpassed.

WATCH DOG DISK METERS are made in sizes from $\frac{5}{8}$ " to 2". The Gear Train has all bearings bushed with hard vulcanized rubber. The spindles, pinions and gears are phosphor bronze. Our special patented Stuffing Box consists of a hard vulcanized rubber plug turned to an angle of 60 degrees ground into a bronze bearing and held in place and made absolutely water-tight by internal pressure, thus being self-adjusting; the higher the pressure the tighter the joint.

The Current Meter is peculiarly fitted to measure heavy flows of water with very small loss of head. It occupies an intermediate position between meters using the Venturi principle and positive meters, having the advantage of being a mechanical meter occupying small space.

WATCH DOG CURRENT METERS are made *entirely* brass. No iron used, neither for Outer Casing, nor even for bolts and nuts. When cover is removed, the Measuring Chamber is exposed to view; can be readily inspected, easily removed. Single Wheel, pressure top and bottom, removes strain upon end bearing. Wheel is hard rubber. Gear Train is our well known type, using the internal Stuffing-box device. Flanges are drilled A.S.M.E. standard. Made in sizes from $1\frac{1}{2}$ " to 6". 8", 10", 12", and 16" size meters designed to meet varied conditions.



Watch Dog Disk Meter



6" Watch Dog Current Meter

105,000 Installed During Last Six Years

Your Inquiries Are Invited

NATIONAL METER COMPANY

Established 1870

84-86 CHAMBERS ST.

NEW YORK CITY

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PITTSBURG, 4 Smithfield St.

ATLANTA, 3d Nat. Bank Bldg.

LOS ANGELES, 411 S. Main St.

SAN FRANCISCO, 141 New Montgomery St.

WINNIPEG, MANITOBA, 229 Spence St.

LONDON, Caxton House

MANUFACTURERS OF WATER METERS AND GAS ENGINES

THE CROWN is a positive displacement water meter of the rotary piston type.

This meter has been made and sold by us for over thirty years. It is substantial, durable and accurate. We make this meter in sizes from $\frac{5}{8}$ " to 6".

THE EMPIRE is a positive displacement water meter of the oscillating piston type. It is the most accurate, durable and generally satisfactory meter manufactured today. Owing to the simple construction of its measuring chamber the accuracy of this meter can be maintained indefinitely at a minimum cost. It is made in sizes from $\frac{5}{8}$ " to 6".

THE NASH is a positive displacement water meter of the disc type. This meter has been on the market for over twenty-five years. The reinforced disc, frost proof bottom and straight reading register are a few of its many superior advantages. The meter is made in sizes from $\frac{5}{8}$ " to 6".

THE GEM is a water meter of the velocity or current type and has been made by us since 1870. It is intended for service when a large and rapid delivery of water is of special advantage. The Gem has the greatest capacity of any meter of its type on the market. It is made in sizes from 2" to 12".

THE PREMIER is a water meter constructed of a Venturi Tube and a by pass on which an accurate, positive displacement meter is installed. This meter is intended to measure the complete supply of a city or other large service. The Premier is made in sizes from 8" to 48".

THE EMPIRE COMPOUND is a water meter constructed by combining our Empire and Gem meters. It will measure with great accuracy large and small flows, and will operate most satisfactorily under greatly varying conditions. The Empire section is always open. The Gem section is controlled by a check valve which opens automatically when called upon to measure a stream larger than the capacity of the Empire. This meter is made in sizes from 2" to 12".

Our meters form a standard by which all others are judged.

No matter what your conditions may be, we can offer you the

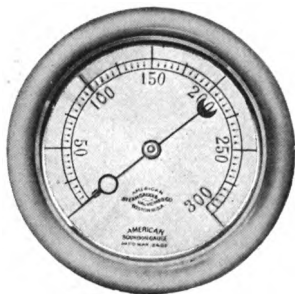
Best Meter for Your Service.

AMERICAN STEAM GAUGE & VALVE MANUFACTURING CO.

FACTORY AND GENERAL OFFICES, BOSTON, MASS.

SALES OFFICES: NEW YORK, CHICAGO, ATLANTA, PITTSBURGH

**MANUFACTURERS OF STEAM TRAPS, GAUGES, VALVES, INDICATORS,
AND KINDRED APPLIANCES FOR GOVERNING, INDICATING, MEAS-
URING, RECORDING AND CONTROLLING STEAM, WATER, AIR, GAS,
OIL, AMMONIA, AND ALL OTHER PRESSURES**



Bourdon Gauge

AMERICAN GAUGES are the simplest in construction, yet so designed that maximum efficiency with longest service is assured to the user. Gauges are too often judged or selected from superficial inspection only, with little or no attention to interior construction—the vital part. In American Gauges only the best material and workmanship will be found, as well as accuracy. This means dollars in every sense of the word to the owner, in both operating and maintenance expense. We furnish gauges for every purpose, and especially invite inquiries for installations

where operating conditions are unusually severe. Estimates promptly furnished.

AMERICAN RECORDING GAUGES

The economical operation of power is safely guarded by the use of accurate, durable Recording Gauges. American Recorders are constructed in the same reliable, workmanlike manner that is characteristic of all our products. The style of case is the same as our non-recording instruments, thus giving uniformity to gauge board installations. Highest grade clock movements are used, insuring accurate time records. Standard chart 8 inch, 24 hour. Special charts to order. Each gauge fitted with our improved fountain pen, requiring filling monthly. We specialize in engine room gauge boards complete, and invite inquiry.



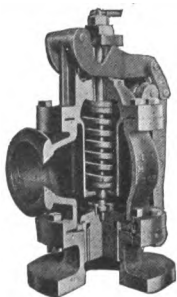
Recording Gauge

AMERICAN SPECIAL POP SAFETY VALVE

This valve is designed embodying the best features found in our experience during the thirty years of spring loaded safety valve existence. Constructed of the highest grade materials, tested under actual working conditions, simple, efficient, and of few working parts, all being easily accessible, and *all* adjustments made from *outside* valve casing. It is the best in valve construction.

This valve is also made in outside spring pattern for superheated steam.

Our sixty-three years record is behind our guarantee covering all goods which we manufacture.



Sectional View

CROSBY STEAM GAGE & VALVE CO.

EXECUTIVE OFFICES

40 CENTRAL ST., BOSTON, MASS.

STORES: BOSTON, 38 Central Street

NEW YORK, Hudson Terminal Bldg., Dey Street

CHICAGO, 180 No. Market Street

LONDON, ENG., 147 Queen Victoria Street

MANUFACTURERS OF STANDARD STEAM APPLIANCES

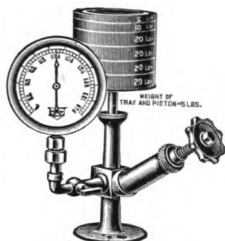


Crosby Pressure Gage

We present for the consideration of Mechanical Engineers certain instruments of our manufacture which we believe are scientifically and mechanically the best of their kind yet produced.

GAGES

For any and all purposes.



Crosby Pressure Gage Tester

RECORDING GAGES

Daily, weekly or continuous records, for Pressure, Vacuum, Hydraulic, etc.

GAGE TESTING INSTRUMENT

Made on scientific principles and is mathematically correct.

REVOLUTION COUNTERS

Positive in action, reliable, durable.



Crosby Revolution Counter

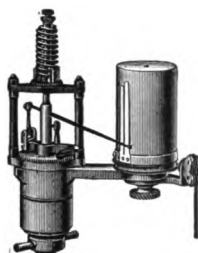
RECORDING COUNTERS

An instrument of wide application and of the greatest usefulness to engineers.

INDICATORS

Steam, Gas, Hydraulic, etc.

As perfect in workmanship and operation as human skill can devise.



Crosby New Indicator

Also Lanza Continuous Diagram Appliance—Reducing Wheels—Boiler Test Pumps—Vacuum Pump—Planimeters—Electrically operated Chime Whistles—Valves for steam, ammonia, etc.

All CROSBY Quality

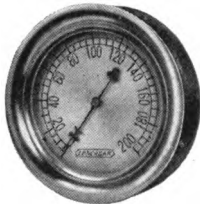
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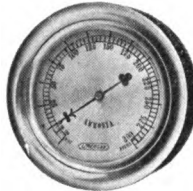
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MANUFACTURERS OF BOILER, STEAM & GAS ENGINE SPECIALTIES

QUALITY  GAUGES



Pressure Gauge

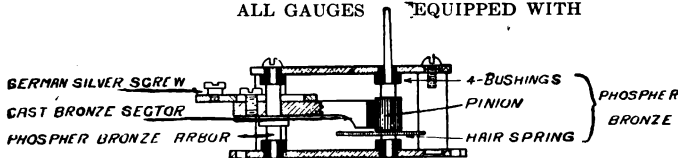


Ammonia Gauge



Hydraulic Gauge

ALL GAUGES EQUIPPED WITH



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"Movement" for all of our high-grade gauges.

All wearing bearings have PHOSPHOR BRONZE BUSHINGS twice their diameter in length.

Sector, cast bronze, with face three times as wide as the regular sector.

Pinion, Arbor and Hair Spring, made of PHOSPHOR BRONZE.

This insures a gauge with exceptional wearing qualities, long life and accuracy.

"Springs" made for hard work.

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Type "D" Short Spring, strong, non-freezable.

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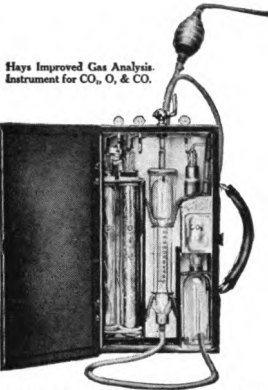
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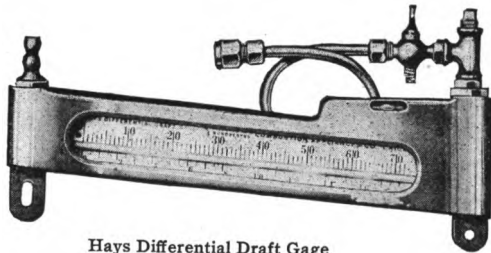
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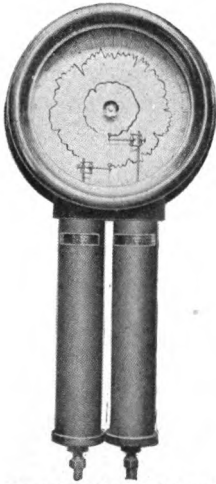
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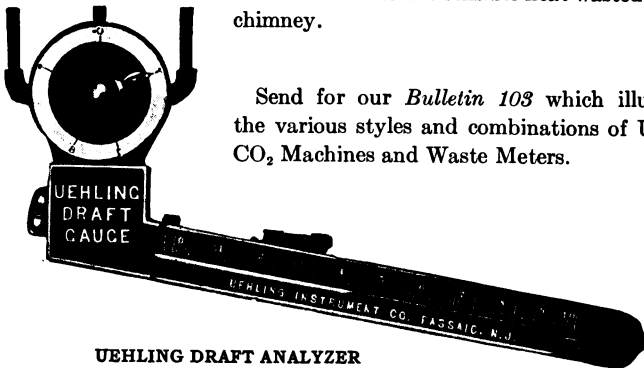
Instruments for Measuring and Recording Vacuum, Pressure, Draft, Temperature, CO₂, Differential Pressure, Absolute Pressure, Barometric Pressure, Speed, Time, Etc.



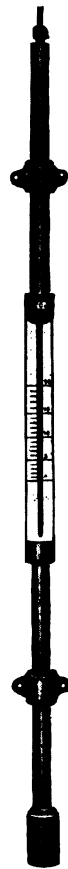
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The per cent of CO₂ in the products of combustion is a true index of the excess air used, therefore the lower the per cent of CO₂ the greater the volume of products of combustion per pound of fuel consumed, and since all gases leave the boiler at stack temperature the per cent of CO₂ in the products of combustion bears a direct relation to the sensible heat wasted up the chimney.



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A Most Important Adjunct to Boiler Room Equipment



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Indicator
for Boiler
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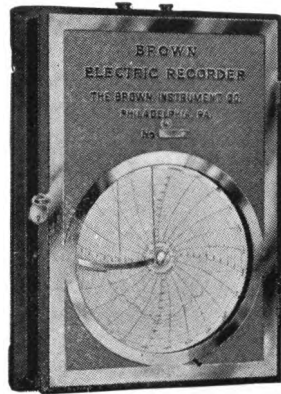
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These well-known instruments operate on the thermo-electric principal for all ranges of temperature from 300° F. to 3000° F. For temperatures below 300° F., resistance thermometers are supplied while for temperatures above 3000° F., the Brown Radiation Pyrometer is extensively used. Pyrometers are also made to regulate or control automatically the temperature of electric, gas and oil furnaces.

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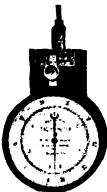


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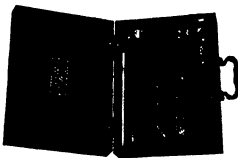
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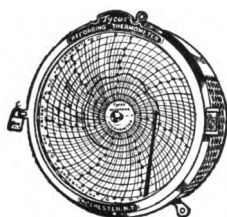
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"Tycos" Recording Thermometers give continuous records of temperature. Made in both self contained and flexible tube form for all industrial applications. Range -40° to 1000° Fahr.

H & M "Tycos" Automatic Temperature and Pressure Regulators for processes requiring uniformity of Temperature or pressure conditions. Type "A" illustrated here has a separable sleeve. Regulator can be removed from tank without drawing off contents.

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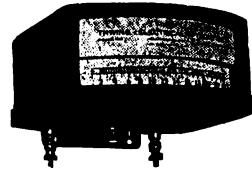
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For stack temperatures, feed water, steam and furnace temperatures our Thermocouple Pyrometers are made with base metal or platinum thermocouples

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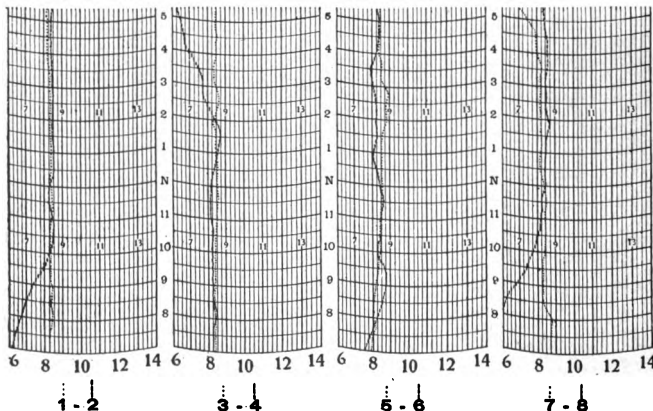
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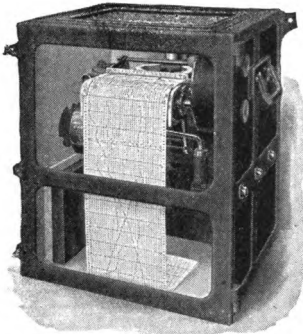
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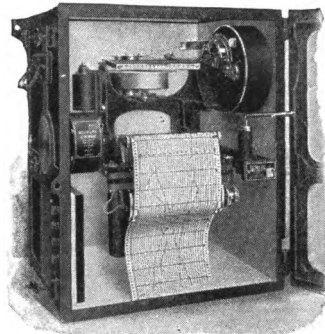
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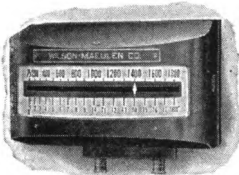
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TAPALOG with carriage lowered for convenient change of paper and typewriter ribbon.

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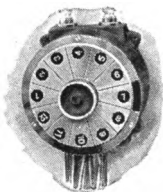
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We make four different patterns of wall indicators.



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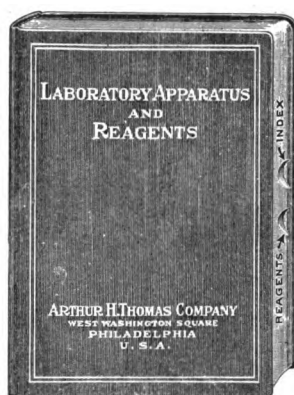
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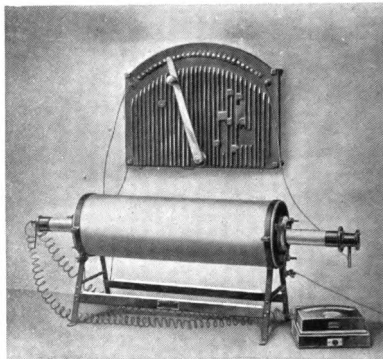
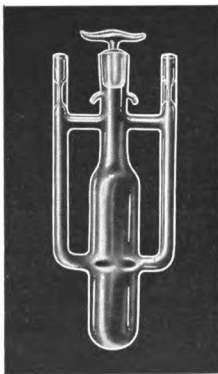


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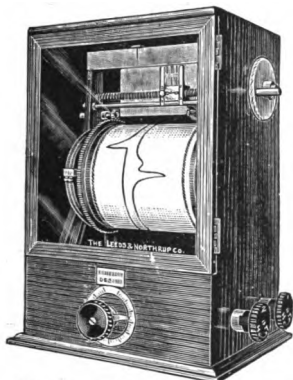
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PHOTOMETRIC APPARATUS. Our line includes everything from standard lamps to complete laboratory equipments, including Ulbricht spheres.

POTENTIOMETERS. For standardization of volt and ammeters and purposes requiring accurate measurement of direct current E.M.F. or currents. We have the Type K Potentiometer, the Brooks' Deflection Potentiometer and the White Potentiometer.

KEYS. We are prepared to furnish keys for all electrical testing purposes.

CATALOGUES

Let us know in what lines you are interested and full and complete catalogues will be mailed you.



Type S Portable Wheatstone Bridge

ROLLER-SMITH COMPANY

203 BROADWAY, NEW YORK

CHICAGO

WORKS: BETHLEHEM, PA.

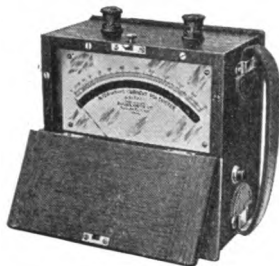
CLEVELAND

ELECTRICAL INSTRUMENTS, METERS AND CIRCUIT BREAKERS

ROLLER-SMITH ELECTRICAL INSTRUMENTS



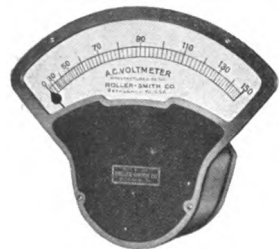
"Portable Standard" D. C. Voltmeter



"General Service" A. C. Voltmeter



"R.R." Type Voltmeter



"I.D." Type Voltmeter

D. C. PORTABLES

Our "General Service" Type is used for all ordinary work. Standard voltmeters furnished with ranges of 3-750 volts. Ammeters have ranges of 1-500 amperes. Size 7x7x4¼ in., weight about 5 lbs.

Our "Portable Standard" Type is recommended for all work requiring dependability and precision. Dead beat, have zero adjusters, mirrors under needle. Improved d'Arsonval mechanism. Made in sizes with range of 75-1,500 M.V. and 3-750 volts. Range of ammeters from 25-1500 M.A. and 5-1000 amp.

A. C. PORTABLES

In our "General Service" Type standard voltmeters have ranges of 15-600 volts, ammeters of 1-300 amp. Size is 7x7x4¼ in., weight about 5 pounds. This type has electro-magnet movement.

Our "Portable Standard" Type is used for laboratory use and for precision measurements in general. Range of standard voltmeters is 3-600 volts. Ammeters have range of 250 mil-amp., 1-1000 amp.

D. C. SWITCHBOARD INSTRUMENTS

Made in "I. P." (Isolated Plant) Type, 7½" diam.; "R. R." (Regular Round) Type, 9½" diam. and "I. D." (Illuminated Dial) Type, 13¼x11½". Dead beat. Scales begin at zero and are evenly divided. Cases dust-proof. All except "I. P." type have zero adjusters. Finish dead black. All back connection. All ranges.

"Imperial" Type, 3 and 4 in. diam. For battery charging panels and small switchboards of all kinds. Permanent magnet type, accurate, and dead beat. Voltmeters up to 250 V. ammeters up to 200 A.

A. C. SWITCHBOARD INSTRUMENTS

Made in "I. P." 7½" diam.; "R. R." 9½" diam. and "I. D." 13¼x11½" types. Electro-magnet movement. Dead beat. Dust proof cases. Standard finish, dead black. All ranges. Scales are not evenly divided and are not readable below 20% of full capacity.

MISCELLANEOUS

Portable Ohmmeter. A most convenient instrument for all ordinary resistance measurements and extremely simple to operate. Close readings are obtainable, there being 4 ranges, each on a scale 30 inches long. Weight 11 lbs., size 17x5x5 in.

All types are strongly made and will stand harder use than similar instruments of other makes.



ROLLER-SMITH COMPANY

ROLLER-SMITH CIRCUIT BREAKERS

D. C. & A. C.

STANDARD TYPE

Principle of Operation: The breaker is closed by pulling down the handle. The arm is under compression against the brush and tends to open on account of the spring of its coil, but it is held closed by the roller on the handle. A slight kick from the armature knocks it back across the center line and the breaker flies open. The breaker may be made more or less sensitive as desired.

Overload types have an overload coil for each pole. Narrow construction permits close spacing on switchboard. Finish, polished copper and dead black. Spade handles for 300 amp. and over. Rated amp. capacity from 5-6000.

There is only one contact and it is laminated. There are no delicate parts anywhere. All parts are built to wear and there is nothing to get out of order. Bearings of nickel bronze, non-rustable.

Plain Overload. Independent arm type is composed of single pole units, not inter-connected. This is of advantage on D.C. and single phase circuits in that they are thrown in successively and the circuit is thus protected against closing on an initial overload. The Rigid Arm type is mechanically inter-connected and is used mostly on polyphase circuits.

Underload. Underload circuit breakers are used chiefly with storage batteries to cut off before current drops to a point where it is likely to reverse. Coil is in series and trips breaker when current drops to about 10% of rated amperes.

No-Voltage. These breakers open the circuit when the line voltage falls to about 30% of normal.

Shunt Trip. The shunt trip is a device for opening the circuit from distant points, as by means of push buttons or limit contacts. It consists of an extra coil (or coils) which are usually operated by current supplied from the main circuit.

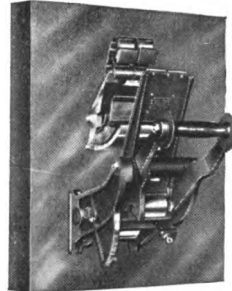
INDUSTRIAL TYPE

The "Industrial" Circuit Breakers operate on the same principle as the standard type, but are somewhat more simple and of less expensive construction. They are intended for use on circuits of 250 volts and under, D.C. or 440 volts and under, A.C. Mounting, front connection type, slate bases and with terminal lugs. Finish, frame and handle black, copper parts dipped and lacquered. Operation, pull down on handle to close, and up to open. Rated amp. capacity from 3-100. Single and multi-pole. Overload, underload, no-voltage, shunt-trip and reverse current.

REVERSE CURRENT RELAYS

(For D. C. Circuits)

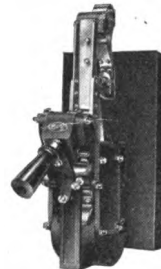
Primarily designed for use in connection with shunt trip circuit breakers. Also suitable for all purposes wherein it is desired to bring about a circuit connection on attainment of a given current value.



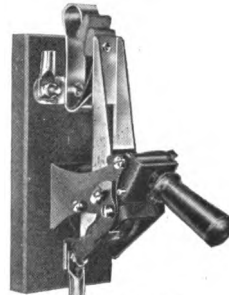
Plain Overload Type



Plain Underload Type



Shunt Trip Type



Industrial Type, Plain Overload

TINIUS OLSEN TESTING MACHINE CO.

**500 NORTH 12TH STREET
PHILADELPHIA, PA.**

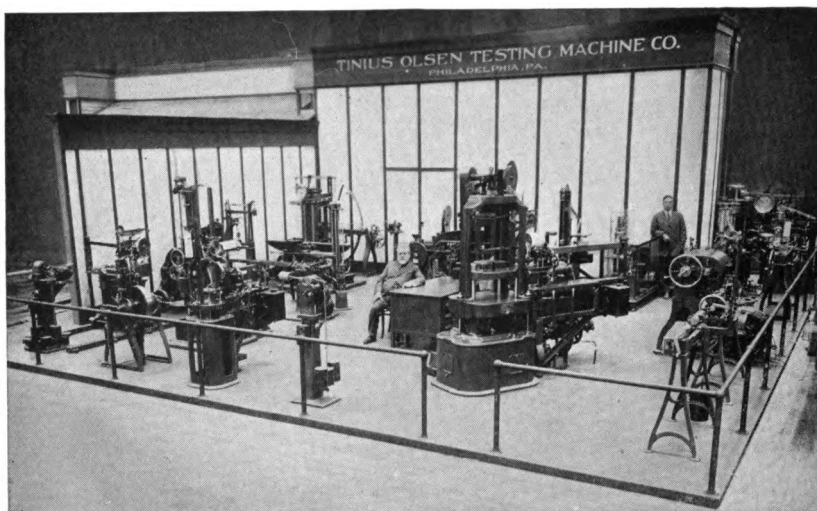
TESTING MACHINERY AND INSTRUMENTS

The largest manufacturers of high grade testing machines in the world.

Builders of the largest testing machine in the world of 10,000,000 lbs. capacity used by the U. S. Bureau of Standards, at Arsenal Grounds, Pittsburgh, Penna.

The following illustration is of our exhibit of testing machinery at the Panama-Pacific International Exposition in San Francisco which covers the most complete up-to-date testing laboratory ever demonstrated.

This exhibit was awarded GRAND PRIX, the highest and only award of this kind ever made to a testing machine manufacturer.



In this exhibit are thirty different types of testing machines with the addition of a complete set of accessories and instruments. The exhibit is illustrated and described by our souvenir exposition pamphlet entitled "Olsen Testing Machines," which will be mailed on request.

Our Catalog covers all the latest up-to-date testing machines and is divided into eight parts as follows:

- Part A—Universal Testing Machines and Instruments.
- Part B—Spring Testing Apparatus and Machinery.
- Part C—Cement, Concrete and Road Materials Testing Machinery.
- Part D—Cloth, Yarn, Paper, Rubber and Leather Testing Machinery.
- Part E—Wire, Chain, and Anchor Testing Machinery.
- Part F—Oil Testing Machinery and Dynamometers.
- Part G—Special Testing Machinery, Including Impact, Indentation, Vibratory, Bending, Hardness, Endurance, Torsion, Fatigue and Efficiency Testing Machines.

Any parts will be mailed on request.

Testing machines designed and built to meet any special requirements.

Our experts will be glad to recommend and lay out complete testing laboratories when desired.

RIEHLÉ BROS. TESTING MACHINE CO.

1424 N. NINTH STREET, PHILADELPHIA, PA.

TESTING MACHINES AND TESTING APPLIANCES

We are the oldest and largest Testing Machine manufacturers in the United States. Established nearly 50 years ago. The Riehlé Testing Machines are used by the leading Colleges, Steel and Iron Works, United States Government, many foreign Governments, and are recommended by many of the most prominent and successful Engineers throughout the world. We design and build these machines from 5000 lbs. to 2,000,000 lbs. and over in capacity for the determination of any physical property.

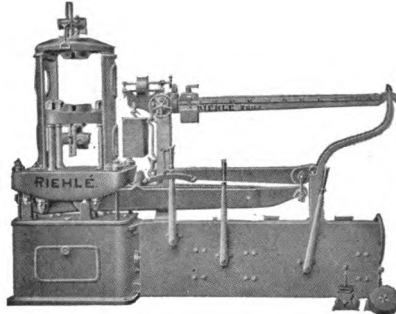
Features of Riehlé Testing Machines

Designed Right.
Plenty Strong Enough.
No Sparing of Material.
Long Base Lines.
Simple in Construction.
All Parts Accessible, without taking whole machine apart.
Fine Finish. Attractive in Appearance.

NOTE

We are now building all the Riehlé Vertical Screw Power-Testing Machines with two (2), three (3), or four (4) Main Pulling Screws as may be desired.

For quick and convenient reference our complete line of Testing Machines is catalogued as enumerated below:



Riehlé U. S. Standard Vertical Screw-Power Testing Machine. Three Screw Type, 100,000 Lbs. Capacity

RIEHLÉ TESTING MACHINE CATALOGUE "A"

Illustrating and describing all the large Riehlé U. S. Standard Testing Machines, Screw and Hydraulic Power, also new and ingenious tools for same; Machines for Long Transverse Members, Torsional and Impact Testing, also Calibrating Levers.

RIEHLÉ CATALOGUE "AA" OF EXTENSOMETERS, COMPRESSOMETERS, AND TORSION METERS.

Containing illustrations and descriptions of the very latest and best Riehlé Extensometers, etc.

RIEHLÉ TESTING MACHINE CATALOGUE "B"

Embracing all the various styles of Riehlé U. S. Standard Testers for Wire, Cloth, Canvas, Cord, Twine and Textile Fabrics of all kinds, also for every variety of test. This Catalogue is well worth your careful perusal.

RIEHLÉ CHAIN TESTING MACHINE CATALOGUE "C"

In this Catalogue is found all that is *newest and best* in Testing Machinery for Chain, Wire, Hemp, Rope, Eye-Bars, Bridge Irons, etc. Special Machines for different forms of materials can be designed along these lines. We also furnish Hydraulic Pumps separately if desired. We claim these Machines are the Strongest and Best in the World.

RIEHLÉ TESTING MACHINE CATALOGUE "D"

Containing illustrations of Transverse Bending, and Special Testing Machines, Rope Twisters, Loam Mills, Pipe Provers, etc. Every Foundry and Machine Shop should install some of the articles shown in this Catalogue.

RIEHLÉ TESTING MACHINE CATALOGUE "E"

Those interested in Machines for testing Springs of all kinds, also Oils and Bearing Metals, are specially referred to this Catalogue for all the newest and best Machines.

RIEHLÉ CATALOGUE "F"

In this Catalogue are presented illustrations and descriptions of superior designs and patterns of Hand and Power Hydraulic Pumps and Presses, also Riehlé-Robie Patented Screw Jacks, etc.

RIEHLÉ CEMENT-TESTING MACHINE CATALOGUE "G"

In this Catalogue one will find "everything that is good" in the way of testing Cements, Asphalts, Building Material, and also every conceivable article for thoroughly equipping a Physical Testing Laboratory for that kind of work. Be sure and send for this Catalogue.

RIEHLÉ ROAD MATERIALS TESTING MACHINE CATALOGUE "K"

In this Catalogue you will find illustrations of everything to make tests of Road Materials, as used by the United States Government, Department of Public Roads, Washington, D. C.

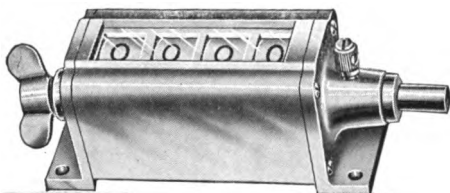
Select the CATALOGUES you want when ready to order.

THE VEEDER MANUFACTURING CO.

HARTFORD, CONN.

MAKERS OF CYCLOMETERS, ODOMETERS, TACHOMETERS, TACHODOMETERS, COUNTERS, SPEED COUNTERS AND FINE DIE CASTINGS

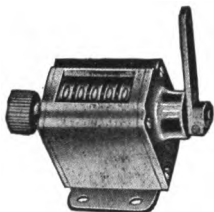
LARGE SET BACK COUNTER



(Cut $\frac{1}{2}$ size)

Sets to zero with one turn of the knob. Furnished in three types of gearing, namely, Revolution, Direct Drive and Rotary Ratchet. They can also be furnished with lock and key instead of reset knob and thus avoid possible tampering. The figures are large and can easily be read at a distance of ten feet.

Price, \$7.50 up.



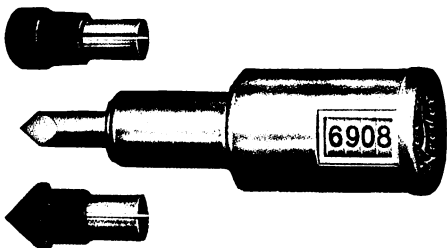
(Cut $\frac{1}{2}$ size)

SMALL SET BACK COUNTER

This Set Back Counter is smaller than the one shown above, but very durable. It sets to zero with one turn of the knob, is furnished with either Revolution or Ratchet Gearing and can be supplied with lock and key instead of reset knob.

Price, \$4.00.

CLUTCH SPEED COUNTER NO. 21



(Cut $\frac{3}{4}$ size)

For finding revolutions per minute made by a shaft or any revolving part. A stop watch is not needed because of the clutch in the counter. A ball thrust bearing is provided for the spindle. The straight reading index is easy to read and avoids errors.

Price, \$3.00.

We make counters for almost every conceivable purpose:

CYCLOMETERS

For Bicycles and Motorcycles, to Register the Distance Traveled.

ODOMETERS

For Automobiles and Horse-Drawn Vehicles, to Measure Distance Traveled.

COUNTERS

To Register Revolutions or Reciprocating Movements. Twenty-five Styles.

SPEED COUNTERS

For Finding the Revolutions per minute made by a Shaft or Any other Revolving Part.

TACHODOMETERS

To Indicate the Speed and Record the Distance Traveled, both Trip and Total. For use on Automobiles, Locomotives and Electric Railway Cars.

TACHOMETERS

To Indicate Speed in Revolutions per Minute of Shafts, Generators, Motors, etc.

FINE DIE CASTINGS

Where Large Numbers of Absolutely Uniform Small Parts are Required.

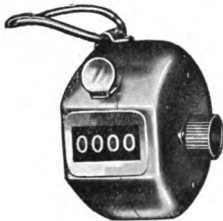
Every mechanical engineer should have a copy of our complete catalogue, which describes more than 25 styles of counters. It will be supplied free upon receipt of application.

THE VEEDER MANUFACTURING CO.

HARTFORD, CONN.

MAKERS OF CYCLOMETERS, ODOMETERS, TACHOMETERS, TACHODOMETERS, COUNTERS, SPEED COUNTERS AND FINE DIE CASTINGS

HAND TALLY COUNTER



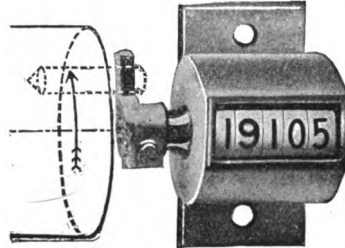
(Cut ½ size)
Price, \$4.00.

Sets to zero with one turn of the knob.

No. 4 REVOLUTION COUNTER

Arrow shows direction shaft turns for Regular Print.

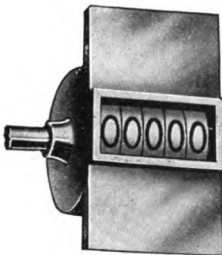
Center of shaft must align with center of Counter.



(Cut full size)

Price, \$1.00.

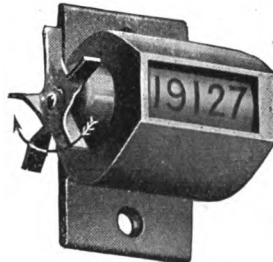
FLANGE AT WINDOW CASE COUNTER



(Cut full size)

Can be furnished with Revolution, Direct Drive or Ratchet Gearing.

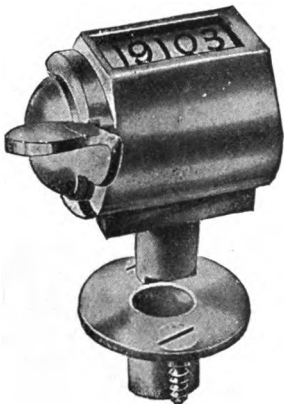
No. 7 STAR REVOLUTION COUNTER



(Cut full size)

Price \$1.25.

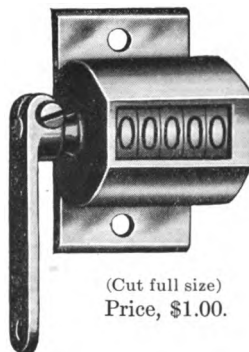
No. 8 TELEPHONE COUNTER



(Cut full size)
Price \$1.50.



No. 6 ROTARY RATCHET COUNTER



(Cut full size)
Price, \$1.00.

THE C. J. ROOT COMPANY

50 BRIDGE ST., BRISTOL, CONN.

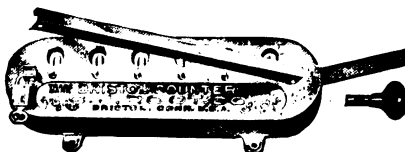
AUTOMATIC COUNTERS, HINGES, METAL STAMPINGS, ETC.

ROOT COUNTERS



"Bristol" Counter

No.	Size Ins.	Ship. Wt. Lbs.	List Price
4	6 1/4 x 2 1/2 x 1 1/8	3 1/2	\$4.40
5	8 x 2 1/2 x 1 1/8	3 1/2	5.00
6	9 1/4 x 2 1/2 x 1 1/8	4 1/2	6.00

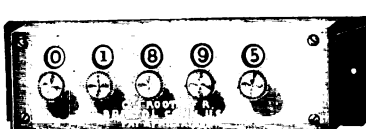


"Bristol" Counter with Lock Bar (Open)

No.	Size Ins.	Ship. Wt. Lbs.	List Price
04	6 1/4 x 2 1/2 x 1 1/8	3 1/2	\$5.25
05	8 x 2 1/2 x 1 1/8	3 1/2	6.00
06	9 1/4 x 2 1/2 x 1 1/8	4 1/2	7.00

Finish: Nickel Plated, Black Enameled, or Copper Oxidized.

Number of Counter corresponds with number of figures.

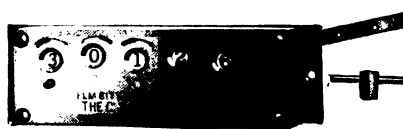


"Elm City" Counter

No.	Size Ins.	Ship. Wt. Oz.	List Price
12	3 1/4 x 1 1/4 x 5/8	12	\$3.00
13	4 x 1 1/4 x 5/8	15	3.90
14	4 3/4 x 1 1/4 x 5/8	18	5.00
15	5 1/2 x 1 1/4 x 5/8	21	5.80
16	6 1/4 x 1 1/4 x 5/8	24	6.80

Finish: Polished Brass, Whitened Dials.

Number of Counter corresponds with number of figures.



"Elm City" Set-Back Counter

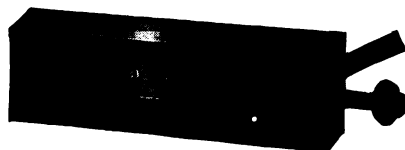
No.	Size Ins.	Ship. Wt. Oz.	List Price
113	4 x 1 1/4 x 5/8	15	\$5.00
114	4 3/4 x 1 1/4 x 5/8	18	6.00
115	5 1/2 x 1 1/4 x 5/8	21	7.00
116	6 1/4 x 1 1/4 x 5/8	24	8.00

We also make the "Elm City" WITH LOCK BAR. Specifications same as above.

No. 96 "Ro-co" Counter
Operated by Rotating Shaft, No Springs

No.	Size Ins.	Ship. Wt. Lbs.	List Price
95 (5 Fig.)	8 x 2 3/4 x 1 1/4	4	\$6.00
96 (6 Fig.)	9 1/2 x 2 3/4 x 1 1/4	5	7.00

Black Enamel Finish

No. 26 "Ro-co" Counter
Reciprocating TypeNo. 26 (6 Fig.) Size 6 1/4 x 1 1/4 x 1 1/8 ins. Ship.
Wt. 30 oz. List Price, \$8.00.
In Nickel Plated or Copper Oxidized Finish

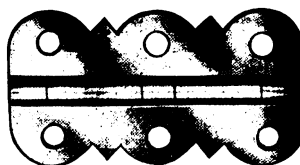
"Ro-co" Counter, Closed Case

No.	Size	List Price
54. (4 Fig.)	4 3/4 x 1 1/4 x 1 1/8 ins.	\$3.80
55. (5 ")	5 1/2 x 1 1/4 x 1 1/8 " "	4.40
56. (6 ")	6 1/4 x 1 1/4 x 1 1/8 " "	5.00

Made entirely without springs and has a nickel plated closed case.

PLEASE WRITE FOR CATALOG M FOR COUNTERS

These counters can be shipped by Parcel Post at small expense.

Catalogue W for
Hinges and
Stampings.

DATA SECTION

**Mechanical Engineering
Data**

301

Pages 303—334

On the following pages are engineering data selected from the Transactions, Volume 36, 1914, and from The Journal, 1914, of The American Society of Mechanical Engineers.

The material from the Transactions includes original data derived by the authors of papers presented to the Society and embodied in those papers.

The data from The Journal are taken from the Engineering Survey Section, which includes abstracts from publications of foreign societies. The origin of these data may be obtained by consulting The Journal references.

CLASSIFICATION OF AMERICAN COALS

A new classification of American coals, based on the proximate and ultimate analyses and heating values of 155 coals from different States selected from the analyses of over 3000 coals published in Bulletin 22 of the U. S. Bureau of Mines, is as follows:

CLASSIFICATION AND HEATING VALUE OF COALS

	Volatile Matter per Cent of Combustible	Oxygen in Combustible per Cent	Moisture in Air Dry Coal Free from Ash per Cent	B.t.u. per Lb. Combustible	B.t.u. per Lb. Coal Air Dry Ash Free
I Anthracite.....	less than 10	1 to 4	less than 1.8	14,800 to 15,400	14,600 to 15,400
II Semi-anthracite....	10 to 15	1 to 5	less than 1.8	15,400 to 15,500	15,200 to 15,500
III Semi-bituminous..	15 to 30	1 to 6	less than 1.8	15,400 to 16,050	15,300 to 16,000
IV Cannel*.....	45 to 60	5 to 8	less than 1.8	15,700 to 16,200	15,500 to 16,050
V Bituminous, high grade.....	30 to 45	5 to 14	1 to 4	14,800 to 15,600	14,350 to 15,500
VI Bituminous, med- ium grade.....	32 to 50	6 to 14	2.5 to 6.5	13,800 to 15,100	13,400 to 14,400
VII Bituminous, low grade.....	32 to 50	7 to 14	5 to 12	12,400 to 14,600	11,300 to 13,400
VIII Sub-bituminous and lignite.....	27 to 60	10 to 33	7 to 26	9,600 to 13,250	7,400 to 11,650

* Eastern cannel. The Utah cannel is much lower in heating value.

Classes I, II and III are the same as in earlier classifications, the semi-bituminous coals containing between 15 and 30 per cent of volatile matter in the combustible. Classes V, VI and VII have heretofore been considered as a single class, but they vary greatly in heating value and in the amount of moisture remaining in air-dried coal, which is used as the basis of the sub-division into three classes. Class VIII includes the two classes sub-bituminous and lignite of the U. S. Geological Survey, which are differentiated one from the other by color, texture and disintegration by weathering, but not by heating value or by analysis.

[*Wm. Kent. Trans., 1914, p. 199*]

POWDERED COAL EXPLOSIONS

Coal, however finely comminuted, does not contain the elements necessary for its own combustion, and if ignited will burn only slowly if kept in a compact mass. It is only when diffused in a cloud that the oxygen of the atmosphere can get to it quickly enough to make the rate of combustion dangerous. The pulverized fuel can be safely conveyed en masse in suitable holders, in screw conveyors, or even in cars and barrows if care is taken that it shall not be blown or sifted about in a finely disseminated state.

[*F. R. Low. Trans., 1914, p. 135*]

POWDERED COAL

Grades Successfully Used. A good average analysis is

Volatile matter, per cent	39
Fixed carbon	53
Ash	8
Sulphur	2 or lower
B.t.u.	13,600

The one essential is high volatile content. Coals high in sulphur give trouble, due to spontaneous combustion. Gas slack is cheaper than run of mine gas coal.

Storage. Dry coal can be stored indefinitely. Two sides of bin should be sloping to prevent bridging.

Drying. Coal should be dried to at least 1 per cent moisture for ease of pulverizing.

Fineness. Ninety-five per cent should pass through a 100-mesh screen and 80-85 per cent through a 200-mesh screen.

Cost of Pulverizing. The table below gives cost figures obtained from actual practice over five years with Raymond system of pulverizing.

COST OF PULVERIZING COAL

Capacity of grinding room, tons per hour	Percentage through 100 mesh	Percentage through 200 mesh	H.P. AT $\frac{1}{4}$ CENTS KW-HR.			LABOR		Cost per ton for maintenance	Total cost per ton cents
			Total h.p. required	Hours per ton	Cost per ton cents	Men at \$2 per day	Cost per ton		
1	99	95	45	45.0	22.5	1	20.0	6.66	49.16
2	95	82	45	22.5	11.25	1	10.0	3.33	24.58
2	99	95	60	30.0	15.0	1	10.0	3.40	28.40
3	95	82	60	20.0	10.0	1	6.66	2.22	20.88
3	99	95	85	28.0	14.0	1	6.66	2.40	23.06
4	95	82	75	19.0	9.5	1	5.0	1.70	16.20
5	95	82	85	17.0	8.5	1	4.0	1.20	13.70
6	99	95	170	28.0	14.0	1	3.33	2.40	19.73
10	95	82	170	17.0	8.5	1	2.0	1.20	11.70
10	99	95	255	28.0	14.0	2	4.0	2.40	20.40
25	95	82	425	17.0	8.5	2	1.7	1.20	11.40
25	99	95	680	28.0	14.0	3	2.4	2.40	18.80

Burner. The essentials of a good burner are (a) uniform speed (b) proper mixture of coal and air (c) proper control, ability to vary coal supply (d) simplicity and (e) compactness.

Air Pressure Used in Powdered Fuel Burning. Coal is blown into the furnace under 6 or 8 oz. pressure. This air supplies only a portion of that needed for combustion, the balance being drawn into the furnace through openings around or near the burners.

[Symposium on Powdered Fuel. Trans., 1914, p. 137]

CEMENT BURNING

The weight of pulverized coal required for burning in Portland cement kilns is approximately (a) in the dry process of manufacture from 22 to 26 per cent of weight of cement produced, i.e., 83 to 100 lb. of coal per bbl. (b), in the wet process from 35 to 50 per cent, i.e., from 133 to 190 lb. of coal per bbl. The capacity of the modern kiln when operating on dry material with flue gases about 1000 deg. fahr., can be approximately expressed by

$$C = \frac{D^2 L}{24}$$

where C = capacity in 24 hours in bbl. of 380 lb.

D = outside diameter in ft.

L = length in ft.

[R. C. Carpenter. *Trans.*, 1914, p. 92]

FLOORS IN FIREPROOF BUILDINGS

TYPE OF FLOOR

The materials suitable for different conditions are:

Basements: Granolithic finish with trowelled surface made with approved materials and workmanship.

Factory Floors: Granolithic finish with trowelled surface; hardwood.

Machine Shops: Granolithic finish with trowelled surface; hardwood on substantial base.

Ground Floors for Heavy Manufacturing: Wood block; granolithic.

Warehouses: Granolithic with trowelled surface; asphalt composition; hardwood.

Offices: Hardwood; linoleum on concrete; magnesium composition.

Corridors and Halls for Institutions and Office Buildings: Terrazzo; granolithic finish with ground surface.

Entrance Pavilions: Terrazzo; mosaic; tile; natural stone.

Class Rooms, Lecture Rooms, and Drawing Rooms: Linoleum on concrete; granolithic with ground surface; hardwood; magnesium composition.

Laboratories: Granolithic with trowelled surface; magnesium composition; tile; hardwood.

Lavatories: Terrazzo; granolithic finish with ground surface; tile.

APPROXIMATE COST

The following prices are based on estimates of cost in place. For the materials like hardwood that are laid after the partitions are placed, the prices apply more particularly to a building such as a college or other institution divided into offices and rooms of various sizes. Each price is assumed to include total cost of the labor and material, exclusive of the structure itself. It is assumed that the base upon which the floor is laid is either structural concrete or some similar material.

Cost per sq. ft.

Granolithic:

If laid at same time as base, with trowelled surface	\$0.05
If laid at same time as base, with ground surface	0.08
If laid after completion of base, and trowelled	0.07
If laid after completion of base, and ground	0.10

Linoleum:

Battleship linoleum including \$0.03 per sq. ft. for placing and trowelling a $\frac{3}{4}$ -in. layer of mortar immediately after base concrete is laid, linoleum being figured at \$1.30 per sq. yd., cemented in place	0.18
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Hardwood:

Maple or birch, single thickness, including \$0.01 for leveling off base concrete and including stringers with cinders between, with rough 1-in. floor underneath	0.22
Maple or birch, single thickness, including \$0.01 for leveling off base concrete and including stringers with cinders between	0.18
Maple or birch, single thickness, including \$0.01 for leveling off base concrete and including stringers with cinders between, with rough 2-in. floor underneath	0.25

These prices are based on good quality of hard wood at about \$45 per 1000 ft. B. M.

Terrazzo:

With small stone $\frac{1}{8}$ in. to $\frac{1}{2}$ in. including \$0.01 for leveling the base concrete	0.19
With large stone $\frac{3}{8}$ in. to 1 in. including \$0.01 for leveling the base concrete	0.24

For areas of 50,000 sq. ft. or more, deduct 10 per cent from these figures.

Base 6 in. high 0.36-0.50 per lin. ft.

Marble Mosaic:

Grouted and ground	0.50-0.60
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Magnesium Composition:

For large areas, say 100,000 sq. ft., including \$0.01 for leveling base concrete	0.20
For small areas, say 25,000 sq. ft., including \$0.01 for leveling base concrete	0.24

Asphalt Flooring:

Including \$0.01 for leveling base concrete	0.15-0.17
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Asphalt Mastic:

For areas 100,000 sq. ft. or more including \$0.01 for leveling base concrete	0.15-0.16
In chemical laboratories	0.17-0.18
6-in. sanitary base	0.25 per lin. ft.

Tile:

Quarry tile	0.35-0.40
Fancy pattern tile	0.50

Cork Tile:

Moravian tile, fancy pattern	0.75-1.25
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SPECIFICATIONS FOR LAYING GRANOLITHIC FINISH ON SET CONCRETE

Specifications for laying granolithic finish on set concrete are as follows:

- a* Roughen surface of base concrete at the age of about 24 hours, so as to remove most of surface scum.
- b* If surfaces have not been thus roughened, pick with a bushhammer to remove a part but not all of the surface skin.
- c* Spread dilute muriatic acid about one part acid to four parts water over the surface, allow to stand for a few minutes, then soak thoroughly with water, and wash off the surface.
- d* Sweep off the excess water on the surface of the concrete and spread on a coating about $\frac{1}{8}$ in. thick of neat cement paste, and broom it well into the concrete. (Do not use dry cement for this.)
- e* Mix the granolithic in proportions 1 part cement to $\frac{3}{4}$ parts coarse sand, like Plum Island, to $1\frac{1}{4}$ part crushed granite screened through a $\frac{3}{4}$ -in. screen and caught on $\frac{1}{8}$ -in. dust jacket.
- f* Make the consistency of granolithic rather stiff so that the mortar will just flush to the surface.
- g* Have the screeds laid parallel and level so that the granolithic can be spread even with straight-edge. Run over the screeds. See that plenty of material is being pushed ahead of the straight-edge at all times so as to avoid pockets in the surface.
- h* Ram granolithic with light square-faced tamper.
- i* Float granolithic surface as soon as it begins to stiffen.
- j* Trowel granolithic surface hard as soon as the proper stage has been reached. (If surface is to be ground do not give surface this final trowelling.)
- k* Cover the surfaces of the granolithic with wet burlap or similar material which will hold water about 24 hours after laying. Wet material each day, and oftener if necessary, for a period of 14 days.

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GENERAL REQUIREMENT

Never lay concrete finish in cold weather unless a uniform temperature can be maintained by artificial heat, as the cold prevents the surface of the granolithic from hardening satisfactorily. In laying floors where water is to be used, care should be exercised to provide the required slope for cleaning and drainage. This is especially necessary in such places as chemical laboratories.

GRINDING GRANOLITHIC SURFACES

Specifications for grinding granolithic surfaces are as follows:

- a* Lay the granolithic as described above but omit the final trowelling.
- b* Rub the granolithic surface by hand with carborundum block at the age of about 24 hours after placing. Rub lightly and take off only the top scum of the cement and remove any surface irregularities.
- c* Grind the surfaces with a floor polishing machine at the age of about 7 days (time varies with weather and temperature). Use about 60-80 grit and do not use any sand unless it is found necessary. This grinding should take off the top film of the surface and cut

into the sand grains enough to expose them and to leave the surface smooth but not shiny.

d Rub wet cement paste into any pinholes.

[S. E. Thompson. *Trans.* 1914, p. 387]

MACHINE GRINDING

The successful working of a grinding wheel depends upon securing in its operation the correct grain depth of cut for that particular wheel on a specified kind of work.

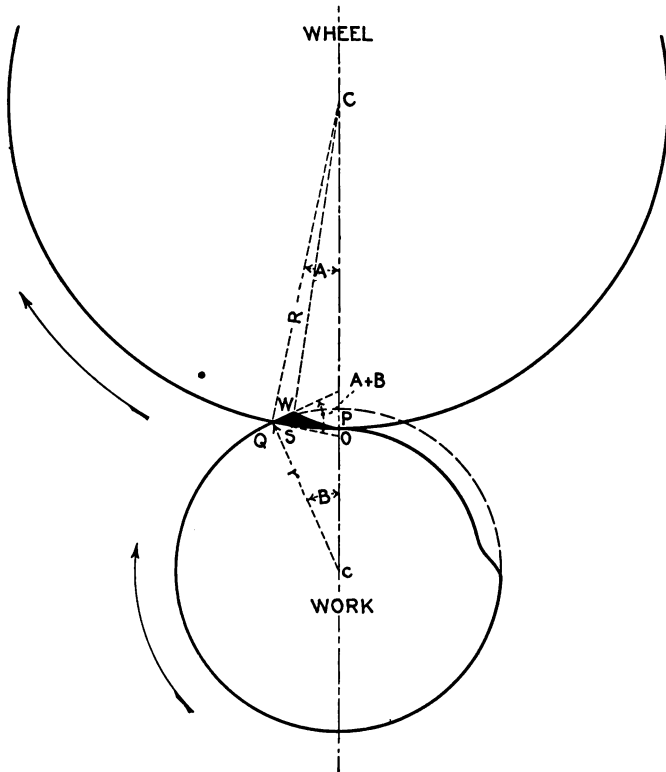


FIG. 1 ACTION OF GRINDING WHEEL WHEN OPERATING UPON CYLINDRICAL WORK

A general equation for grain depth of cut is

$$d = \frac{v}{Vn} \sin (A+B)$$

where V = surface velocity of wheel

v = surface velocity of work

d = grain depth of cut

$A+B$ = angle between tangents at first point of contact of wheel and work (Fig. 1)

n = number of cutting particles per unit length of circumference of wheel

MECHANICAL ENGINEERING DATA

The following tables furnish a means for determining change in grain depth of cut due to changes in radial depth:

TABLE 1 ARCS OF CONTACT

Radial Depth of Cut, Inches		0.0005	0.001	0.0015	0.002	0.0025	0.003
12-in. Wheel	Work Diam., Inches	ARCS OF CONTACT					
	1/2	0.0158	0.0210	0.0270	0.0307	0.0346	0.0378
	1	0.0212	0.0318	0.0373	0.0429	0.0482	0.0526
	2	0.0291	0.0413	0.0507	0.0584	0.0654	0.0711
	3	0.0346	0.0490	0.0600	0.0692	0.0775	0.0848
	4	0.0386	0.0547	0.0689	0.0775	0.0866	0.0949
	6	0.0448	0.0634	0.0774	0.0894	0.1001	0.1095
	8						
	12						
	24						
	∞	0.0775	0.1095	0.1342	0.1549	0.1732	0.1898

TABLE 2 SIN (A + B)

Radial Depth of Cut, Inches		0.0005	0.001	0.0015	0.002	0.0025	0.003
12-in. Wheel	Work Diam., Inches	SIN (A + B)					
	1/2	0.06581	0.09678	0.10999	0.12807	0.14379	0.15724
	1	0.04686	0.06888	0.08084	0.09287	0.10439	0.11396
	2	0.03394	0.04822	0.05914	0.06816	0.07626	0.08294
	3	0.02879	0.04075	0.04997	0.05768	0.06453	0.07066
	4	0.02573	0.03649	0.04589	0.05163	0.05769	0.06323
	6	0.02238	0.03167	0.03868	0.04469	0.05002	0.05475
	8						
	12						
	24						
	∞	0.01291	0.01826	0.02236	0.02582	0.02886	0.03162

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In applying the principle that grain depth of cut is the main factor in all the phenomena of a good grinding wheel, it must be remembered that the correct relative speeds of work and of wheel must be found by trial for each wheel and each kind of work. When this has been done, the principle of grain depth of cut will enable one to know the direction in which to make the changes of work speed or wheel speed, to adapt the wheel to changes in its own diameter, or to other sizes of the same kind of work.

[G. I. Alden. *Trans.*, 1914, p. 451]

NATURAL GAS CHARACTERISTICS

In calculations of compression of natural gas at various points in the transmission line, in determinations of conditions of flow of gas by the various line flow formulæ and in the measurement of gas sold to consumers, the laws of perfect gases have been assumed, with error.

Natural gas from the mid-continental field contains over 80 per cent methane, CH₄, for which the following equations have been determined:

EQUATION FOR CONSTANT PRESSURE

$$P = 50 \text{ lb.}, \quad T = 75.4 \text{ }^\circ\text{F}$$

MECHANICAL ENGINEERING DATA

$$\begin{aligned} P &= 100 \text{ lb.}, & T &= 152.5 \text{ } V \\ P &= 200 \text{ lb.}, & T &= 280 \text{ } V + 50 \\ P &= 300 \text{ lb.}, & T &= 427 \text{ } V + 50 \\ P &= 400 \text{ lb.}, & T &= 539 \text{ } V + 80 \\ P &= 500 \text{ lb.}, & T &= 584 \text{ } V + 150 \end{aligned}$$

EQUATION FOR CONSTANT VOLUME

$$\begin{aligned} V &= 2, & T &= 2.87 \text{ } P + 40 \\ V &= 4, & T &= 6.51 \text{ } P - 50 \\ V &= 6, & T &= 8.80 \text{ } P \\ V &= 8, & T &= 12.0 \text{ } P \\ V &= 10, & T &= 15.2 \text{ } P \end{aligned}$$

The value of n in the equation $P V^n = \text{constant}$, usually taken in natural gas calculations as 1.266, is for methane:

Pressure range lb. per sq. in.	Temperature range deg. fahr.	Value of n
220 to 158.5	212 to 174	1.120
111 to 82.5	212 to 174	1.174
182 to 158.5	105 to 90	1.174
94.5 to 82.5	105 to 90	1.170

EXAMPLE

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Suppose an amount of natural gas is sold by measurement in a pipe line under a static pressure of 300 lb. absolute, the amount being such that an actual volume of 1,000,000 cu. ft. passes the measuring mechanism. Under the usual contract the price is fixed per cubic foot at some stated pressure at or near atmospheric. Assume this to be 14.7 lb. and the temperature at the measuring point is the same as the standard. With the usual method of calculating equivalent volume, then:

$$\text{Volume at 14.7} = 1,000,000 \times \frac{300}{14.7} = 20,410,000 \text{ cu. ft.}$$

With correct values taken isothermal for methane for 32 deg. fahr.,

$$\text{Volume at 14.7} = 1,000,000 \times \frac{22.4}{1.053} = 21,270,000 \text{ cu. ft.}$$

$$\text{Error} = 100 \left(1 - \frac{20410}{21270} \right) = 4.03 \text{ per cent.}$$

At rate of 18 cents per thousand cu. ft. this means a loss of

$$0.18 \times \frac{21,270,000}{1,000} \times 0.0403 = \$15.43$$

In purchasing natural gas measured at high pressure, and selling it at a measurement made at low pressure, there is a gain in volume to the handling company, if Boyle's Law is applied in the calculation of equivalent volumes.

[P. F. Walker. *Trans.*, 1914, p. 781]

ASH FUSION TESTS

Fig. 2 shows an arrangement of apparatus for conducting Seger cone tests and obtaining consistent results. The table below shows results obtained with the apparatus.

The apparatus includes a Meker furnace and a Le Chatelier pyrometer. Size of cone 8 mm. base by 30 mm. high. Water as binder. Cone close to pyrometric element.

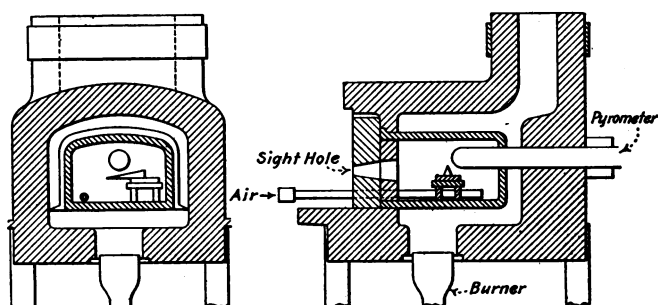


FIG. 2 APPARATUS FOR CONDUCTING SEGER CONE TESTS

MELTING TEMPERATURE OF ASH AND FIRE ROOM RECORD OF CLINKERING

Date	MELTING TEMPERATURES DEG. CENT. (FAHR.)		Amount and character of clinker
	Initial and final bending	Range	
Feb. 3	1350-1395 (2462-2543)	45 (81)	Light
4	1360-1400 (2480-2552)	40 (72)	Light
5	1360-1400 (2480-2552)	40 (72)	Light
6	1340-1380 (2444-2516)	40 (72)	Light
10	1360-1375 (2480-2507)	15 (27)	Hard, excessive; 50 per cent of grate
13	1350-1395 (2462-2543)	45 (81)	Excessive to moderate; large clinker
Mar. 3	1370-1420 (2498-2588)	50 (90)	Not much but very hard and isolated
5	1350-1370 (2462-2498)	20 (36)	Excessive; 75 per cent of grate
11	1355-1380 (2471-2516)	25 (45)	Heavy
13	1340-1395 (2444-2543)	55 (99)	Heavy
17	1430-1480 (2606-2696)	50 (90)	Light
24	1420-1450 (2588-2642)	30 (54)	Very little
26	> 1500 (> 2732)		Light, hard
Apr. 8	1335-1370 (2435-2498)	35 (63)	Excessive, very hard, 18 to 20 in. in V and thick

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[L. S. Marks. *Trans.*, 1914, p. 811]

HARDENING FURNACES

For good practice the following points should be taken care of:

- a The furnace and hearth should be of sufficient size so as not to be affected materially in temperature by the introduction of the parts to be hardened.
- b The furnace should heat at a uniform rate.

- c The furnace should be of uniform temperature over its entire hearth.
- d The furnace should be run under neutral, or reducing, conditions. A good rough test for this is the introduction of a piece of wood or paper upon the hearth. If the paper, or wood, burn, the atmosphere is oxidizing. If they char, reducing or neutral.
- e The temperature control must be exact at all times and it must be possible of exact duplication on repetition work.

The kind of fuel used, whether gas or oil, is immaterial.

[J. A. Mathews and H. J. Stagg, Jr. *Trans.*, 1914, p. 865]

HARDNESS OF IRON

The hardness of iron or steel is due to the percentage of carbon alloyed with the metal. This percentage varies according to the grade of the iron or steel. Wrought iron and dead low steels contain practically no carbon. Structural steels contain from 0.2 per cent to 0.4 per cent; rolled steel wheels 0.7 per cent; rail steel 0.8 per cent; tool steels run as high as 2 per cent, and the tread of chilled iron wheels runs as high as 3.5 per cent. The hardness is directly proportional to the amount of carbon present. Fig. 3 shows the relation of hardness and ductility to the percentage of carbon.

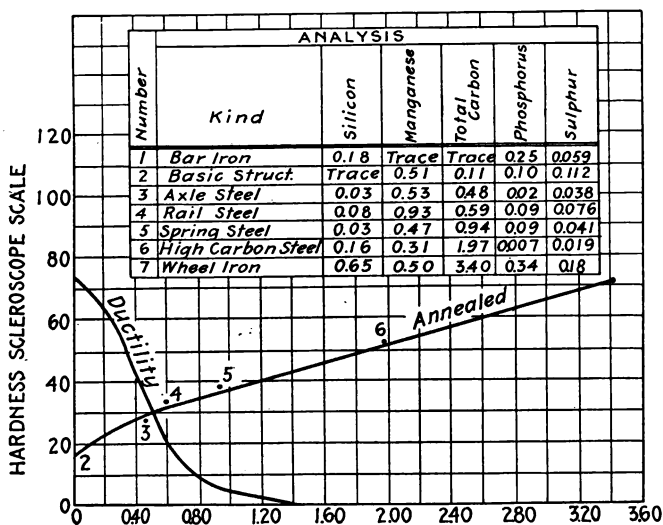


FIG. 3. HARDNESS COMPARISON OF IRON AND STEEL ACCORDING TO CARBON CONTENTS

The figure shows that with carbon at 3.5 per cent, the tread of a chilled iron wheel is intensely hard. The wearing value of chilled iron is therefore superior to that of any other metal used in the manufacture of wheels.

[F. K. Vial. *Trans.*, 1914, p. 877]

BOILER MATERIALS

The following values of ultimate strengths of boiler materials should be used in all computations (lb. per sq. in.)

Tensile strength of steel plate.....	55,000
Crushing strength of steel plate.....	95,000
Strength of iron rivets in single shear.....	38,000
Strength of iron rivets in double shear.....	76,000
Strength of steel rivets in single shear.....	44,000
Strength of steel rivets in double shear.....	88,000

The minimum thickness of any boiler plate under pressure should be $\frac{1}{4}$ in.

The minimum thicknesses of shell plates, and dome plates after flanging, should be:

WHEN THE DIAMETER OF SHELL IS

36 In. or Under	Over 36 In. to 54 In.	Over 54 In. to 72 In.	Over 72 In.
$\frac{1}{4}$ in.	$\frac{5}{16}$ in.	$\frac{3}{8}$ in.	$\frac{1}{2}$ in.

The minimum thicknesses of butt straps should be as given below:

MINIMUM THICKNESSES OF BUTT STRAPS

Thickness of shell plates, in.	Minimum thickness of butt straps, in.	Thickness of shell plates, in.	Minimum thickness of butt straps, in.
$\frac{1}{4}$	$\frac{1}{4}$	$\frac{17}{32}$	$\frac{7}{16}$
$\frac{5}{32}$	$\frac{1}{4}$	$\frac{9}{16}$	$\frac{7}{16}$
$\frac{5}{16}$	$\frac{1}{4}$	$\frac{5}{8}$	$\frac{1}{2}$
$\frac{11}{32}$	$\frac{1}{4}$	$\frac{3}{4}$	$\frac{1}{2}$
$\frac{3}{8}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{3}{8}$
$\frac{13}{32}$	$\frac{5}{16}$	1	$\frac{3}{4}$
$\frac{7}{16}$	$\frac{3}{8}$	$1\frac{1}{8}$	$\frac{3}{4}$
$\frac{15}{32}$	$\frac{3}{8}$	$1\frac{1}{4}$	$\frac{3}{4}$
$\frac{1}{2}$	$\frac{7}{16}$		

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The minimum thicknesses of tube sheets for horizontal return tubular boilers should be:

WHEN THE DIAMETER OF TUBE SHEET IS

42 In. or Under	Over 42 In. to 54 In.	Over 54 In. to 72 In.	Over 72 In.
$\frac{3}{8}$ in.	$\frac{7}{16}$ in.	$\frac{1}{2}$ in.	$\frac{9}{16}$ in.

The minimum thickness of tubes used in water-tube boilers measured by Birmingham wire gage, for maximum allowable working pressures not exceeding 165 lb. per sq. in., should be as follows:

Diameter	B.W.G.
Less than 3 in.....	No. 12
3 in. or over, but less than 4 in.....	No. 11
4 in. or over, but less than 5 in.....	No. 10
5 in.....	No. 9

The above thicknesses should be increased for maximum allowable working pressures higher than 165 lb. per sq. in. as follows:

Over 165 lb. but not exceeding 235 lb..... 1 gage

MECHANICAL ENGINEERING DATA

Over 235 lb. but not exceeding 285 lb.....	2 gages
Over 285 lb. but not exceeding 400 lb.....	3 gages

The minimum thicknesses of tubes used in fire tube boilers measured by Birmingham wire gage, for maximum allowable working pressures not exceeding 175 lb. per sq. in., should be as follows:

Diameter	B.W.G.
Less than 2½ in.....	No. 13
2½ in. or over, but less than 3¼ in.....	No. 12
3¼ in. or over, but less than 4 in.....	No. 11
4 in. or over, but less than 5 in.....	No. 10
5 in.....	No. 9

For higher maximum allowable working pressures than given above, the thickness should be increased one gage.

[A. S. M. E. Boiler Code. Trans., 1914, p. 982.]

SPECIFICATIONS FOR LAPWELDED AND SEAMLESS BOILER TUBES

Approved by the Boiler Tube Manufacturers of America, September 25, 1914

I MANUFACTURE

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Process. a Lap welded tubes shall be made of open-hearth steel or knobbled hammered charcoal iron.

b Seamless tubes shall be made of open-hearth steel.

II CHEMICAL PROPERTIES AND TESTS

Chemical Composition. a The steel shall conform to the following requirements as to chemical composition:

Carbon.....	0.08—0.18 per cent
Manganese.....	0.30—0.50 per cent
Phosphorus.....	not over 0.04 per cent
Sulphur.....	not over 0.045 per cent

b Chemical analyses will not be required for charcoal iron tubes.

Check Analyses. a Analyses of two tubes in each lot of 250 (or on total order if less than 250) may be made by the purchaser which shall conform to the requirements specified in Par. 165 (in the Code). Drillings for analyses shall be taken from several points around each tube.

b If the analysis of only one tube does not conform to the requirements specified, analyses of two additional tubes from the same lot shall be made, each of which shall conform to the requirements specified.

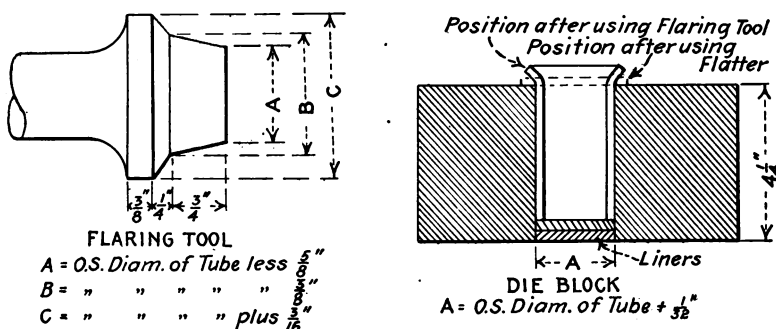
III PHYSICAL PROPERTIES AND TESTS

Flange Test. a A test specimen not less than 4 in. in length shall have a flange turned over at right angles to the body of the tube without showing cracks or flaws. This flange as measured from the outside of the tube shall be ⅝ in. wide.

b In making the flange test, the flaring tool and die block as shown in the figure, may be used.

Flattening Tests. A test specimen 3 in. in length shall stand hammering flat until the inside walls are brought parallel and separated by a distance equal to three (3) times the wall thickness, without showing cracks or flaws. In the case of lapwelded tubes, the test shall be made with the weld at the point of maximum bend.

Hydrostatic Tests. Tubes under 5 in. in diameter shall stand an internal hydrostatic pressure of 1000 lb. per sq. in. and tubes 5 in. in diameter or over, an internal hydrostatic pressure of 800 lb. per sq. in. Lapwelded tubes shall be struck near both ends, while under pressure, with a two-pound hand hammer or the equivalent.



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FIG. 4 DETAILS OF FLARING TOOL AND DIE BLOCK REQUIRED FOR MAKING FLANGE TESTS OF BOILER TUBES

Test Specimens. a All test specimens shall be taken from tubes before being cut to finished lengths and shall be smooth on the ends and free from burrs.
b All tests shall be made cold.

Number of Tests. One flange and one flattening test shall be made from each of two tubes in each lot of 250 or less. Each tube shall be subjected to the hydrostatic test.

Retests. If the results of the physical tests of only one tube from any lot do not conform to the requirements specified in Pars. 167 and 168 (in the Code), retests of two additional tubes from the same lot shall be made, each of which shall conform to the requirements specified.

ETCH TESTS FOR CHARCOAL IRON

Etch Tests.¹ A cross section of tube may be turned or ground to a perfectly true surface polished free from dirt or cracks, and etched until the soft parts

¹ A solution of two parts of water, one part concentrated hydrochloric acid, and one part concentrated sulphuric acid is recommended for the etch test.

MECHANICAL ENGINEERING DATA

are sufficiently dissolved for the iron tube to show a decided ridged surface with the weld very distinct, while a steel tube would show a homogeneous surface.

IV WORKMANSHIP AND FINISH

Workmanship. The finished tubes shall be circular within 0.02 in. and the mean outside diameter shall not vary more than 0.015 in. from the size ordered. All tubes shall be carefully gaged with a B.W.G. gage and shall not be less than the gage specified, except the tubes on which the standard slot gage, specified, will go on tightly at the thinnest point, will be accepted. The length shall not be less, but may be 0.125 in. more than that ordered.

Finish. The finished tubes shall be free from injurious defects and shall have a workmanlike finish and shall be practically free from kinks, bends and buckles.

V MARKING

Marking. The name or brand of the manufacturer, the material from which it is made, whether steel or charcoal iron, and "Tested at 1000 lb." for tubes under 5 in. in diameter, or "Tested at 800 lb." for tubes 5 in. in diameter or over, shall be legibly stenciled on each tube.

VI INSPECTION AND REJECTION

316 *Inspection.* All tests and inspection shall be made at the place of manufacture. The manufacturer of boiler tubes shall furnish the purchaser of each lot of tubes a statement of the kind of material of which the tubes are made, and that the tubes have been tested and have met all the requirements of these rules. This statement shall be furnished to the manufacturer using the tubes and shall be forwarded to the local inspectors of the district in which the boiler is to be inspected.

Rejection. Tubes when inserted in the boiler shall stand expanding and beading without showing cracks or flaws, or opening at the weld. Tubes which fail in this manner will be rejected and the manufacturer shall be notified.

[A. S. M. E. Boiler Code. Trans., 1914, p. 1014]

MEASUREMENT OF FLUIDS

An apparatus for the measurement of fluids in closed channels is described in a paper by A. M. Levin. This apparatus consists of an ordinary elbow or bend, properly calibrated and provided at its outer and inner curved walls with suitable pressure-ports through which the pressures at these points may be transmitted to an ordinary U-tube manometer. Instead of determining the velocity of the fluid from its inertia pressure, as in the pitot tube and venturi meter, the flow-bend utilizes as a gage the centrifugal pressure exerted in deflecting the course of the fluid through a definite path.

NOTATION

If V_m = mean linear velocity, ft. per min.

ρ = mean radius of bend, in.

D = diameter of channel in bend, in.

H = difference between pressure at entrance and delivery, expressed in feet head

p_1 = absolute pressure at entrance, lb. per sq. in.

p_2 = absolute pressure at delivery, lb. per sq. in.

δ_1 = density of fluid at entrance, lb. per cu. ft.

n = ratio of specific heat of fluid at constant pressure and constant volume = 1.405

g = acceleration of gravity

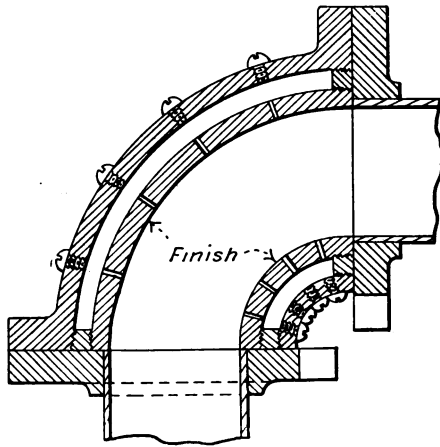


FIG. 5 METERING FLOW-BEND

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the following equations hold for this type of meter

$$V_m = \sqrt{\frac{\rho}{2D}} \cdot \sqrt{2gH}$$

when density of fluid remains unchanged during the flow, as in the case of water

$$V_m = \sqrt{\frac{\rho}{2D}} \cdot \sqrt{2g \cdot 144 \frac{p_1}{\delta_1} \cdot \log_e \frac{p_2}{p_1}}$$

when density of fluid changes at the rate an isothermal compression or expansion would call for

$$V_m = \sqrt{\frac{\rho}{2D}} \cdot \sqrt{2g \cdot 144 \frac{p_1}{\delta_1} \cdot 3.47 \left[\left(\frac{p_2}{p_1} \right)^{0.29} - 1 \right]}$$

when density of fluid changes at the rate an adiabatic compression or expansion would call for.

Hence, the general formulæ for the bend are practically those of the pitot tube covering corresponding cases, with only the factor $\sqrt{\frac{\rho}{2D}}$ added.

[A. M. Levin. Trans., 1914, p. 239]

BOILER TESTS

Following are the results of tests made at the Cleveland Municipal Electric Light Plant at E. 53d Street on Stirling water-tube boilers. Working pressure 250 lb. per sq. in. gage; heating surface 10,134 sq. ft.; superheater for superheating steam 125 deg. fahr.; two Taylor stokers of six retorts to each boiler.

Test.....	Number	1	2	3	4	5
	Duration	25 Hr.	24 Hr.	24 Hr.	12 Hr.	1½ Hr.
Steam pressure, lb.						
Boiler.....		227.52	225.55	224.35	237.48	237.29
Superheater.....		214.78	222.98	226.87	241.72	238.50
Temperature, deg. fahr.						
Superheated steam.....		552.11	529.31	551.39	586.40	608.00
Deg. superheat.....		153.84	131.81	154.28	184.62	206.28
Feed water.....		70.32	71.26	70.11	69.10	70.00
Boiler room.....		78.00	72.30	71.33	72.84	72.10
Factor of evaporation.....		1.2896	1.2769	1.2897	1.3080	1.3182
Water						
Total water.....		1,062,820	699,817	975,138	634,393	108,896
Water per hour.....		42,513	29,159	40,631	52,866	72,598
Total water, f. and a.....		1,370,613	893,596	1,257,635	829,786	143,547
Total water, f. and a. per hr.....		54,825	37,233	52,401	69,149	95,698
Total water, f. and a. per sq. ft.						
H.S.....		5.41	3.68	5.17	6.83	9.45
Coal						
Total coal as fired.....		140,085	82,393	126,702	86,853	16,609
Coal per hr. as fired.....		5,603	3,433	5,279	7,238	11,073
Coal per hr. per retort.....		467	286	440	603	923
Per cent moisture.....		3.65	2.94	4.00	3.16	2.66
Total dry coal.....		134,972	79,971	121,634	84,108	16,167
Dry coal per hr.....		5,399	3,332	5,068	7,009	10,778
Dry coal per hr. per retort.....		450	278	422	584	898
Combustible						
Total combustible.....		116,577	70,191	106,084	71,993	13,432
Combustible per hr.....		4,663	2,925	4,420	5,999	8,955
Combustible per hr. per retort.....		389	244	368	500	746
Evaporation coal as fired.....		7.59	8.49	7.70	7.30	6.56
Evaporation f. and a. dry coal.....		10.15	11.17	10.34	9.87	8.88
Evaporation f. and a. combustible.....		11.76	12.73	11.86	11.53	10.69
Horse power developed.....		1589.1	1079.2	1518.9	2004.3	2773.9
Per cent rating.....		156.87	106.53	149.94	197.86	273.83
Temperature flue gases.....		600.57	510.70	597.82	731.87	832.50
Gas analysis						
Carbon dioxide.....		15.15	16.13	16.58	15.05	15.93
Oxygen.....		3.30	2.28	1.66	3.21	2.66
Carbon monoxide.....		0.05	0.03	0.26	0.51	0.02
Nitrogen.....		81.50	81.56	81.50	81.23	81.39
Drafts						
Furnace.....		-0.09	-0.06	-0.05	-0.09	-0.08
Top first pass.....		+0.19	+0.16	+0.22	+0.16	+0.15
Bottom last pass.....		+0.02	+0.06	+0.04	-0.07	-0.15
Under damper.....		-0.10	+0.07	-0.03	-0.43	-0.95
Stoker data						
Rev. per hour.....		28.44	17.13	30.90	43.50	71.40
Air pressure.....		2.01	1.28	2.10	3.39	5.40
H.p. stoker motor.....		7.13	8.51	10.91	14.20
H.p. fan motor.....		25.09	28.34	41.04	71.60

(Continued on next page)

MECHANICAL ENGINEERING DATA

BOILER TESTS (CONTINUED)

Test.....	Number	1	2	3	4	5
	Duration	25 Hr.	24 Hr.	24 Hr.	12 Hr.	1½ Hr.
Coal analysis						
Moisture.....		3.65	2.94	4.00	3.16	2.66
Volatile matter.....		32.42	32.78	32.58	32.48	32.59
Fixed carbon.....		55.98	55.57	55.55	55.06	55.69
Ash.....		11.61	11.65	11.87	12.47	11.72
Total carbon.....		71.33	72.63	72.38	72.01	72.65
Sulphur.....		1.50	1.77	1.92	2.21	2.10
Hydrogen.....		5.14	4.89	4.89	5.00	4.99
B.t.u. (dry basis).....		13,452	13,369	13,386	13,247	13,353
B.t.u. combustible.....		15,219	15,132	15,189	15,134	15,126
Per cent carbon in ash and refuse.....		22.70	17.28	20.47	33.44	33.35
Combined boiler and grate eff.....		73.22	81.08	74.93	72.30	64.53
Eff. combustible basis.....		74.98	81.64	75.77	73.93	68.58
Total dry ash and refuse.....		18,395	9,780	15,550	12,115	2,735
Per cent ash by test.....		13.63	12.23	12.78	14.40	16.92
Heat balance (dry basis).....	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Heat absorbed by boiler.....		73.22	81.08	74.93	72.30	64.53
Heat loss due to temp. flue gases.....		11.14	9.04	10.38	14.05	15.91
Heat loss due to comb. in ash.....		3.35	2.31	2.86	5.31	6.17
Heat loss due to moist. in coal.....		0.35	0.28	0.39	0.32	0.28
Heat loss due to burning hydrogen.....		4.43	4.12	4.25	4.60	4.71
Heat loss due to carbon monoxide.....		0.18	0.10	0.86	1.81	0.07
Heat unaccounted for.....		7.33	3.07	6.33	1.61	8.33

Boiler pressures have been corrected due to water leg by —12.56 lb. for all tests.

Boiler pressures on tests 1 and 2 have been corrected for 2 lb. for error in gage.

Superheater pressures on tests 1 and 2 have been corrected by —18.5 lb. for error in gages.

[F. W. Ballard. *Trans.*, 1914, p. 675]

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BOILER OPERATION

MAINTENANCE COSTS OF TWO 2365-HP. BOILER UNITS WITH TAYLOR STOKERS

Including Repairs to Boilers, Stokers and Brickwork

	Boiler No. 25	Boiler No. 27
December 1911—Hours steaming.....	442	447
Cost of material and labor.....	\$116.00	\$112.60
January 1912—Hours steaming.....	483	490
Cost of material and labor.....	\$84.86	\$2.88
February 1912—Hours steaming.....	464	462
Cost of material and labor.....	\$63.35	\$77.74
March 1912—Hours steaming.....	424	182
Cost of material and labor.....	\$1.71	\$253.02*
Cost per kw-hr. in 12 boiler installation, with two boilers for one 20,000-kw. turbine (yearly load factor 36 per cent).....		0.0034 cents

* Covers general overhauling of stoker and setting.

[J. W. Parker. *Journal*, 1914, p. 39]

SAFETY VALVES

The A. S. M. E. Boiler Code, published in Volume 36 of the Transactions of the Society, pp. 977 to 1086, contains a table for obtaining the discharge capacities of Direct Spring-Loaded Pop Safety Valves. This table, together with the method of computing it, is here included.

METHOD OF COMPUTING TABLE

Method of Computing Table The discharge capacity of a safety valve is expressed in equations 2 and 3 below as the product of C and H . The discharge capacities are given in the table for each valve size at the pressures shown and are calculated for various valve sizes, pressures and for three different lifts. The discharge capacities are proportional to the lifts, so that intermediate values may be obtained from the table by interpolation.

C = total weight or volume of fuel of any kind burned per hour at time of maximum forcing, lb. or cu. ft.

H = the heat of combustion, B.t.u. per lb. or cu. ft. of fuel used.

D = diameter of valve seat, in.

L = vertical lift of valve disc, in., measured immediately after the sudden lift due to the pop.

P = absolute boiler pressure or gage pressure plus 14.7 lb. per sq. in.

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1100 = the number of B.t.u. required to change a pound of feed water at 100 deg. Fahr. into a pound of steam.

The boiler efficiency is assumed as 75 per cent.

The coefficient of discharge, in Napier's formula, is taken as 96 per cent.

$$\frac{C \times H \times 0.75}{1100 \times 3600} = \frac{3.1416 \times D \times L \times 0.707 \times P \times 0.96}{70} \text{ for valve with 45-deg. seat. (1)}$$

$C H = 160,856 \times P \times D \times L$ for valve with bevel seat at 45 deg. (2)

$C H = 227.487 \times P \times D \times L$ for valve with flat seat at 90 deg. (3)

Safety valve capacity of a boiler may be checked in any one of three different ways:

a By making an accumulation test, by shutting off all other steam discharge outlets from the boiler and forcing the fires to a maximum.

b By measuring the maximum amount of fuel that can be burned and computing the corresponding evaporative capacity upon the basis of the heating value of the fuel.

c By determining the maximum evaporative capacity by measuring the feed water.

(The table follows on pp. 321, 322 and 323.)

[A. S. M. E. Boiler Code. Trans., 1914, p. 1044]

MECHANICAL ENGINEERING DATA

DISCHARGE CAPACITIES FOR DIRECT SPRING-LOADED POP SAFETY VALVES, WITH 45 DEG. BEVEL SEATS

Gage Pres., Lb. per Sq. In.		Diameter, 1 In.			Diameter, 1¼ In.			Diameter, 1½ In.		
		Min.	Int.	Max.	Min.	Int.	Max.	Min.	Int.	Max.
15	Lift, in. . . .	0.02	0.04	0.05	0.03	0.04	0.05	0.03	0.05	0.06
	CH	95,500	191,000	238,900	179,200	238,800	293,500	214,900	358,300	429,900
	Lb. hr. . . .	65	131	163	122	163	203	146	245	293
25	Lift, in. . . .	0.02	0.04	0.05	0.03	0.04	0.05	0.03	0.05	0.06
	CH	127,700	255,400	319,300	239,500	319,300	399,100	287,400	478,900	574,700
	Lb. hr. . . .	87	174	218	164	218	272	196	326	392
50	Lift, in. . . .	0.02	0.04	0.05	0.03	0.04	0.05	0.03	0.05	0.06
	CH	208,200	416,400	520,400	390,300	520,400	650,500	468,300	780,600	936,600
	Lb. hr. . . .	142	284	354	266	354	444	320	532	639
75	Lift, in. . . .	0.02	0.04	0.05	0.03	0.04	0.05	0.03	0.05	0.06
	CH	288,600	577,200	721,400	541,100	721,400	901,800	649,300	1,082,000	1,299,000
	Lb. hr. . . .	197	393	492	369	492	615	443	738	886
100	Lift, in. . . .	0.02	0.04	0.05	0.03	0.04	0.05	0.03	0.05	0.06
	CH	369,000	738,000	922,500	691,900	922,500	1,153,000	830,300	1,384,000	1,661,000
	Lb. hr. . . .	252	503	629	472	629	786	566	944	1133
125	Lift, in. . . .	0.02	0.04	0.05	0.03	0.04	0.05	0.03	0.05	0.06
	CH	449,400	898,900	1,124,000	842,700	1,124,000	1,404,000	1,011,000	1,685,000	2,022,000
	Lb. hr. . . .	307	613	767	575	767	957	689	1149	1379
150	Lift, in. . . .	0.02	0.04	0.05	0.03	0.04	0.05	0.03	0.05	0.06
	CH	529,900	1,059,800	1,325,000	993,500	1,325,000	1,656,000	1,192,000	1,987,000	2,384,000
	Lb. hr. . . .	362	723	904	677	904	1129	813	1355	1625
175	Lift, in. . . .	0.02	0.04	0.05	0.03	0.04	0.05	0.03	0.05	0.06
	CH	610,300	1,220,600	1,526,000	1,144,000	1,526,000	1,907,000	1,373,000	2,289,000	2,746,000
	Lb. hr. . . .	416	833	1040	780	1040	1301	936	1561	1872
200	Lift, in. . . .	0.02	0.04	0.05	0.03	0.04	0.05	0.03	0.05	0.06
	CH	690,700	1,381,400	1,727,000	1,295,000	1,727,000	2,158,000	1,554,000	2,590,000	3,108,000
	Lb. hr. . . .	471	941	1178	883	1178	1472	1060	1766	2119
225	Lift, in. . . .	0.02	0.04	0.05	0.03	0.04	0.05	0.03	0.05	0.06
	CH	771,100	1,542,200	1,928,000	1,446,000	1,928,000	2,410,000	1,735,000	2,892,000	3,470,000
	Lb. hr. . . .	526	1052	1315	986	1315	1643	1183	1972	2366
250	Lift, in. . . .	0.02	0.04	0.05	0.03	0.04	0.05	0.03	0.05	0.06
	CH	851,600	1,703,200	2,129,000	1,597,000	2,129,000	2,661,000	1,916,000	3,193,000	3,832,000
	Lb. hr. . . .	581	1161	1451	1089	1451	1814	1307	2177	2613
275	Lift, in. . . .	0.02	0.04	0.05	0.03	0.04	0.05	0.03	0.05	0.06
	CH	932,000	1,864,000	2,330,000	1,748,000	2,330,000	2,913,000	2,097,000	3,495,000	4,194,000
	Lb. hr. . . .	635	1271	1589	1192	1589	1986	1430	2383	2860
300	Lift, in. . . .	0.02	0.04	0.05	0.03	0.04	0.05	0.03	0.05	0.06
	CH	1,024,000	2,048,000	2,531,000	1,898,000	2,531,000	3,164,000	2,278,000	3,797,000	4,556,000
	Lb. hr. . . .	698	1397	1746	1294	1726	2157	1553	2589	3107

The Discharge capacity of a Flat Seat Valve of a given diameter with a given lift may be obtained by multiplying the discharge capacity given in the Table for a 45 deg. bevel seat valve of same diameter and same lift, by 1.4.

MECHANICAL ENGINEERING DATA

DISCHARGE CAPACITIES FOR DIRECT SPRING-LOADED POP SAFETY VALVES, WITH 45 DEG. BEVEL SEATS

Gage Pres., lb. per Sq. In.		Diameter, 2 In.			Diameter, 2½ In.			Diameter, 3 In.		
		Min.	Int.	Max.	Min.	Int.	Max.	Min.	Int.	Max.
15	Lift, in. . . .	0.04	0.06	0.07	0.04	0.06	0.08	0.05	0.08	0.10
	CH	382,200	573,300	668,900	477,700	716,600	955,500	716,600	1,147,000	1,433,000
	Lb. hr.	261	391	456	326	488	651	489	782	977
25	Lift, in. . . .	0.04	0.06	0.07	0.04	0.06	0.08	0.05	0.08	0.10
	CH	510,900	766,300	894,000	638,500	957,900	1,277,000	957,900	1,533,000	1,916,000
	Lb. hr.	349	523	610	435	653	871	653	1046	1307
50	Lift, in. . . .	0.04	0.06	0.07	0.04	0.06	0.08	0.05	0.08	0.10
	CH	832,600	1,249,000	1,457,000	1,041,000	1,561,000	2,081,000	1,561,000	2,498,000	3,122,000
	Lb. hr.	568	851	994	710	1064	1419	1064	1703	2129
75	Lift, in. . . .	0.04	0.06	0.07	0.04	0.06	0.08	0.05	0.08	0.10
	CH	1,154,000	1,731,000	2,020,000	1,443,000	2,164,000	2,886,000	2,164,000	3,463,000	4,329,000
	Lb. hr.	787	1181	1377	984	1475	1968	1475	2361	2951
100	Lift, in. . . .	0.04	0.06	0.07	0.04	0.06	0.08	0.05	0.08	0.10
	CH	1,476,000	2,214,000	2,583,000	1,845,000	2,768,000	3,690,000	2,768,000	4,428,000	5,535,000
	Lb. hr.	1007	1510	1761	1258	1887	2516	1887	3019	3774
125	Lift, in. . . .	0.04	0.06	0.07	0.04	0.06	0.08	0.05	0.08	0.10
	CH	1,795,000	2,693,000	3,146,000	2,247,000	3,371,000	4,494,000	3,371,000	5,393,000	6,741,000
	Lb. hr.	1224	1836	2145	1531	2299	3064	2299	3677	4596
150	Lift, in. . . .	0.04	0.06	0.07	0.04	0.06	0.08	0.05	0.08	0.10
	CH	2,109,000	3,179,000	3,709,000	2,649,000	3,974,000	5,299,000	3,974,000	6,358,000	7,948,000
	Lb. hr.	1438	2158	2529	1806	2710	3613	2710	4335	5419
175	Lift, in. . . .	0.04	0.06	0.07	0.04	0.06	0.08	0.05	0.08	0.10
	CH	2,441,000	3,662,000	4,272,000	3,051,000	4,577,000	6,103,000	4,577,000	7,323,000	9,154,000
	Lb. hr.	1664	2497	2913	2081	3121	4161	3121	4993	6242
200	Lift, in. . . .	0.04	0.06	0.07	0.04	0.06	0.08	0.05	0.08	0.10
	CH	2,763,000	4,144,000	4,835,000	3,454,000	5,180,000	6,907,000	5,180,000	8,289,000	10,361,000
	Lb. hr.	1884	2826	3296	2354	3532	4709	3532	5651	7064
225	Lift, in. . . .	0.04	0.06	0.07	0.04	0.06	0.08	0.05	0.08	0.10
	CH	3,085,000	4,626,000	5,398,000	3,856,000	5,784,000	7,711,000	5,784,000	9,254,000	11,567,000
	Lb. hr.	2104	3154	3680	2629	3944	5258	3944	6310	7890
250	Lift, in. . . .	0.04	0.06	0.07	0.04	0.06	0.08	0.05	0.08	0.10
	CH	3,406,000	5,109,000	5,961,000	4,258,000	6,387,000	8,516,000	6,387,000	10,219,000	12,774,000
	Lb. hr.	2322	3484	4064	2903	4355	5807	4355	6968	8708
275	Lift, in. . . .	0.04	0.06	0.07	0.04	0.06	0.08	0.05	0.08	0.10
	CH	3,728,000	5,592,000	6,524,000	4,660,000	6,990,000	9,320,000	6,990,000	11,180,000	13,980,000
	Lb. hr.	2542	3813	4448	3177	4766	6355	4766	7620	9533
300	Lift, in. . . .	0.04	0.06	0.07	0.04	0.06	0.08	0.05	0.08	0.10
	CH	4,050,000	6,075,000	7,087,000	5,062,000	7,593,000	10,124,000	7,593,000	12,149,000	15,186,000
	Lb. hr.	2762	4143	4832	3452	5177	6903	5177	8280	10,358

The Discharge capacity of a Flat Seat Valve of a given diameter with a given lift may be obtained by multiplying the discharge capacity given in the Table for a 45 deg. bevel seat valve of same diameter and same lift, by 1.4.

This table is concluded on the following page.

MECHANICAL ENGINEERING DATA

DISCHARGE CAPACITIES FOR DIRECT SPRING-LOADED POP SAFETY VALVES, WITH 45 DEG. BEVEL SEATS

Gage Pres., Lb. per Sq. In.		Diameter, 3½ In.			Diameter, 4 In.			Diameter, 4½ In.		
		Min.	Int.	Max.	Min.	Int.	Max.	Min.	Int.	Max.
15½	Lift, in. . . .	0.06	0.09	0.11	0.07	0.10	0.12	0.08	0.11	0.13
	CH	1,003,000	1,505,000	1,839,000	1,338,000	1,911,000	2,293,000	1,720,000	2,365,000	2,795,000
	Lb. hr.	684	1026	1254	912	1303	1564	1173	1613	1906
25	Lift, in. . . .	0.06	0.09	0.11	0.07	0.10	0.12	0.08	0.11	0.13
	CH	1,341,000	2,012,000	2,459,000	1,788,000	2,554,000	3,065,000	2,299,000	3,161,000	3,736,000
	Lb. hr.	914	1372	1676	1219	1742	2090	1568	2156	2547
50	Lift, in. . . .	0.06	0.09	0.11	0.07	0.10	0.12	0.08	0.11	0.13
	CH	2,186,000	3,278,000	4,007,000	2,914,000	4,163,000	4,996,000	3,747,000	5,152,000	6,088,000
	Lb. hr.	1490	2235	2732	1087	2839	3406	2555	3513	4151
75	Lift, in. . . .	0.06	0.09	0.11	0.07	0.10	0.12	0.08	0.11	0.13
	CH	3,030,000	4,545,000	5,555,000	4,040,000	5,772,000	6,926,000	5,194,000	7,142,000	8,441,000
	Lb. hr.	2066	3099	3788	2754	3935	4722	3542	4870	5756
100	Lift, in. . . .	0.06	0.09	0.11	0.07	0.10	0.12	0.08	0.11	0.13
	CH	3,875,000	5,812,000	7,103,000	5,166,000	7,380,000	8,856,000	6,642,000	9,133,000	10,793,000
	Lb. hr.	2642	3963	4843	3522	5032	6038	4529	6227	7358
125	Lift, in. . . .	0.06	0.09	0.11	0.07	0.10	0.12	0.08	0.11	0.13
	CH	4,719,000	7,079,000	8,652,000	6,292,000	8,988,000	10,786,000	8,089,000	11,123,000	13,146,000
	Lb. hr.	3218	4826	5899	4290	6128	7354	5516	7583	8963
150	Lift, in. . . .	0.06	0.09	0.11	0.07	0.10	0.12	0.08	0.11	0.13
	CH	5,564,000	8,345,000	10,199,000	7,418,000	10,597,000	12,717,000	9,537,000	13,114,000	15,498,000
	Lb. hr.	3794	5690	6954	5058	7226	8670	6503	8940	10564
175	Lift, in. . . .	0.06	0.09	0.11	0.07	0.10	0.12	0.08	0.11	0.13
	CH	6,408,000	9,612,000	11,748,000	8,544,000	12,206,000	14,647,000	10,985,000	15,105,000	17,851,000
	Lb. hr.	4369	6553	8010	5824	8320	9984	7490	10298	12173
200	Lift, in. . . .	0.06	0.09	0.11	0.07	0.10	0.12	0.08	0.11	0.13
	CH	7,253,000	10,879,000	13,296,000	9,670,000	13,814,000	16,580,000	12,433,000	17,095,000	20,204,000
	Lb. hr.	4946	7418	9068	6593	9420	11305	8475	11655	13773
225	Lift, in. . . .	0.06	0.09	0.11	0.07	0.10	0.12	0.08	0.11	0.13
	CH	8,097,000	12,146,000	14,845,000	10,796,000	15,423,000	18,507,000	13,881,000	19,086,000	22,556,000
	Lb. hr.	5521	8280	10120	7361	10514	12616	9465	13013	15383
250	Lift, in. . . .	0.06	0.09	0.11	0.07	0.10	0.12	0.08	0.11	0.13
	CH	8,942,000	13,412,000	16,393,000	11,922,000	17,031,000	20,438,000	15,328,000	21,076,000	24,908,000
	Lb. hr.	6097	9143	11175	8130	11614	13938	10448	14366	16980
275	Lift, in. . . .	0.06	0.09	0.11	0.07	0.10	0.12	0.08	0.11	0.13
	CH	9,786,000	14,679,000	17,941,000	13,048,000	18,640,000	22,368,000	16,776,000	23,067,000	27,261,000
	Lb. hr.	6672	10005	12233	8895	12707	15248	11438	15728	18585
300	Lift, in. . . .	0.06	0.09	0.11	0.07	0.10	0.12	0.08	0.11	0.13
	CH	10,630,000	15,946,000	19,489,000	14,174,000	20,249,000	24,298,000	18,224,000	25,058,000	29,614,000
	Lb. hr.	7248	10875	13290	9668	13807	16568	12428	17088	20195

The Discharge capacity of a Flat Seat Valve of a given diameter with a given lift may be obtained by multiplying the discharge capacity given in the Table for a 45 deg. bevel seat valve of same diameter and same lift, by 1.4.

RECOMMENDED STANDARD CROSS-SECTIONS

There are many advantages in using standard cross-sections. They make drawings easier to understand and diminish the danger of interpreting their meaning wrongly.

The following cross-sections for the nineteen materials indicated are recommended:

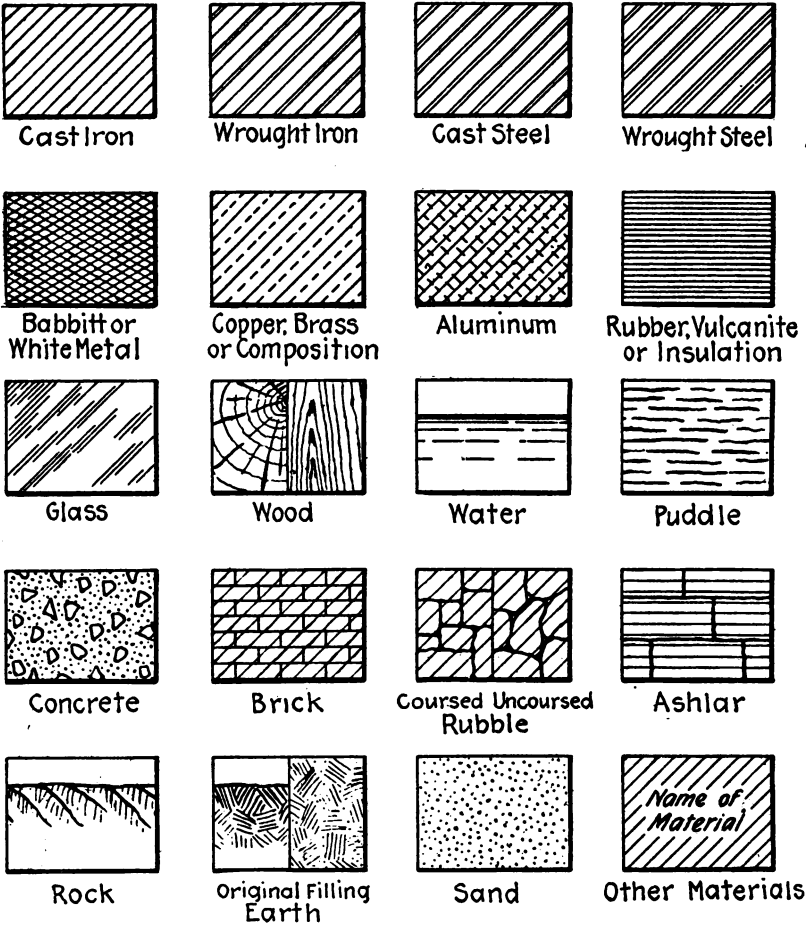


FIG. 6 RECOMMENDED STANDARD CROSS-SECTIONS

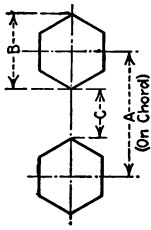
Subdivisions of any of the materials shown may be made by taking one of these standard cross-sections as a basis and making minor changes or by writing on the standard cross-section the name of the material.

[Cross-Sections Committee Report. Trans., 1914, p. 965.]

MECHANICAL ENGINEERING DATA

SCHEDULE OF STANDARD PIPE FLANGES FROM 1 IN. TO 100 IN. FOR 125-LB. WORKING PRESSURE

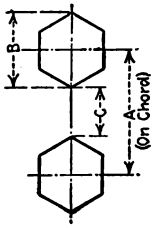
Diameter of Pipe	$P = \text{Pressure per Sq. In.}$ $\left[\frac{P+100}{4 \times S} D + 0.333 \left(1 - \frac{100}{D} \right) \right] 1.2$ ($S = 1800$)	Minimum Thickness (Fractions of an In.)	Stress on Pipe per Sq. In.	Diameter of Flange	Thickness of Flange	Width of Flange Face	Diameter of Bolt Circle	No. of Bolts	Diameter of Bolts	Effective Area	Stress per Sq. In. on Bolt, Metal	Diameter of Bolt Holes	A	B	C
1	0.43	$\frac{1}{4}$	143	4	$\frac{1}{4}$	$1\frac{1}{2}$	3	4	$\frac{1}{4}$	0.093	264	$\frac{1}{4}$	2.12	0.91	1.21
1½	0.44	$\frac{1}{4}$	178	4½	$\frac{1}{2}$	1½	3½	4	$\frac{1}{4}$	0.093	412	$\frac{1}{4}$	2.38	0.91	1.47
2	0.45	$\frac{1}{4}$	214	5	$\frac{1}{2}$	1¾	3¾	4	$\frac{1}{2}$	0.126	438	$\frac{1}{2}$	2.73	1.00	1.73
	0.46	$\frac{1}{4}$	286	6	$\frac{5}{8}$	2	4¾	4	$\frac{5}{8}$	0.202	486	$\frac{3}{4}$	3.35	1.21	2.14
2½	0.48	$\frac{1}{2}$	357	7	$\frac{1}{2}$	2¼	5½	4	$\frac{5}{8}$	0.202	750	$\frac{3}{4}$	3.88	1.21	2.67
3	0.50	$\frac{1}{2}$	428	7½	$\frac{3}{4}$	2½	6	4	$\frac{5}{8}$	0.202	1093	$\frac{3}{4}$	4.23	1.21	3.02
3½	0.52	$\frac{1}{2}$	500	8½	$\frac{1}{2}$	2½	7	4	$\frac{5}{8}$	0.202	1488	$\frac{3}{4}$	4.94	1.21	3.73
4	0.53	$\frac{1}{2}$	500	9	$\frac{1}{2}$	2½	7½	8	$\frac{5}{8}$	0.202	972	$\frac{3}{4}$	2.87	1.21	1.56
4½	0.55	$\frac{1}{2}$	562	9½	$\frac{1}{2}$	2½	7¾	8	$\frac{3}{4}$	0.302	823	$\frac{7}{8}$	2.96	1.44	1.52
5	0.56	$\frac{1}{2}$	625	10	$\frac{1}{2}$	2½	8½	8	$\frac{3}{4}$	0.302	1016	$\frac{7}{8}$	3.25	1.44	1.81
6	0.60	$\frac{3}{4}$	667	11	1	2½	9½	8	$\frac{3}{4}$	0.302	1463	$\frac{7}{8}$	3.63	1.44	2.19
7	0.63	$\frac{3}{4}$	700	12½	1½	2¾	10¾	8	$\frac{3}{4}$	0.302	1991	$\frac{7}{8}$	4.11	1.44	2.67
8	0.66	$\frac{5}{8}$	800	13½	1½	2¾	11¾	8	$\frac{3}{4}$	0.302	2600	$\frac{7}{8}$	4.50	1.44	3.06
9	0.70	$\frac{1}{2}$	818	15	1½	3	13¾	12	$\frac{3}{4}$	0.302	2194	$\frac{7}{8}$	3.43	1.44	1.99
10	0.73	$\frac{3}{4}$	833	16	1½	3	14¾	12	$\frac{7}{8}$	0.420	1948	1	3.69	1.66	2.03
12	0.80	$\frac{1}{2}$	923	19	1¾	3½	17	12	$\frac{7}{8}$	0.420	2805	1	4.40	1.66	2.74
14	0.86	$\frac{7}{8}$	1000	21	1¾	3½	18¾	12	1	0.550	2915	1½	4.86	1.88	2.98
15	0.90	$\frac{7}{8}$	1072	22½	1¾	3½	20	16	1	0.550	2510	1½	3.90	1.88	2.02
16	0.93	1	1000	23½	1½	3¾	21¾	16	1	0.550	2856	1½	4.14	1.88	2.26
18	1.00	1½	1059	25	1½	3½	22¾	16	1½	0.694	2865	1½	4.44	2.00	2.35
20	1.07	1¾	1111	27½	1½	3¾	25	20	1½	0.694	2829	1½	3.91	2.09	1.82



MECHANICAL ENGINEERING DATA

SCHEDULE OF STANDARD PIPE FLANGES FROM 1 IN. TO 100 IN. FOR 125-LB. WORKING PRESSURE (Continued)

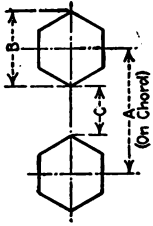
Diameter of Pipe	$P = \text{Pressure per Sq. In.}$ $\left[\frac{P+100}{4+S} D \times 0.333 \left(1 - \frac{D}{100} \right) \right]^{1.2}$ ($S = 1800$)	Minimum Thickness (Fractions of an In.)	Stress on Pipe per Sq. In.	Diameter of Flange	Thickness of Flange	Width of Flange Face	Diameter of Bolt Circle	No. of Bolts	Diameter of Bolts	Effective Area	Stress per Sq. In. on Bolt, Metal	Diameter of Bolt Holes	A	B	C
22	1.13	1 1/4	1158	29 1/2	1 1/4	3 3/4	27 1/4	20	1 1/4	0.893	2660	1 1/4	4.26	2.31	1.95
24	1.20	1 1/4	1200	32	1 1/4	4	29 1/4	20	1 1/4	0.893	3166	1 1/4	4.62	2.31	2.31
26	1.27	1 3/4	1238	34 1/4	2	4 1/4	31 3/4	24	1 1/4	0.893	3096	1 1/4	4.14	2.31	1.83
28	1.33	1 3/4	1273	36 1/2	2 1/4	4 1/4	34	28	1 1/4	0.893	3078	1 1/4	3.81	2.31	1.50
30	1.40	1 3/4	1304	38 3/4	2 1/4	4 3/4	36	28	1 1/4	1.057	2985	1 1/4	4.03	2.53	1.50
32	1.47	1 3/4	1333	41 3/4	2 1/4	4 3/4	38 1/2	28	1 1/4	1.294	2775	1 1/4	4.31	2.75	1.56
34	1.54	1 3/4	1360	43 3/4	2 1/4	4 3/4	40 1/4	32	1 1/4	1.294	2741	1 1/4	3.97	2.75	1.22
36	1.60	1 3/4	1385	46	2 3/4	5	42 3/4	32	1 1/4	1.294	3073	1 1/4	4.19	2.75	1.44
38	1.67	1 1/2	1407	48 3/4	2 3/4	5 3/4	45 1/4	32	1 1/4	1.515	2924	1 1/4	4.43	2.96	1.47
40	1.73	1 1/2	1428	50 3/4	2 3/4	5 3/4	47 1/4	36	1 1/4	1.515	2880	1 1/4	4.11	2.96	1.15
42	1.82	1 1/2	1448	53	2 3/4	5 1/2	49 1/4	36	1 1/4	1.515	3175	1 1/4	4.31	2.96	1.35
44	1.87	1 1/2	1467	55 1/4	2 3/4	5 3/4	51 3/4	40	1 1/4	1.515	3186	1 1/4	4.06	2.96	1.10
46	1.94	1 1/2	1484	57 1/4	2 1/2	5 3/4	53 3/4	40	1 1/4	1.515	3428	1 1/4	4.22	2.96	1.26
48	2.00	2	1500	59 1/2	2 3/4	5 3/4	56	44	1 1/4	1.515	3393	1 1/4	3.98	2.96	1.02
50	2.07	2 1/4	1515	61 3/4	2 3/4	5 3/4	58 3/4	44	1 1/4	1.746	3195	1 1/4	4.14	3.19	0.95
52	2.14	2 1/4	1530	64	2 3/4	6	60 3/4	44	1 1/4	1.746	3456	1 1/4	4.30	3.19	1.11
54	2.20	2 1/4	1543	66 1/4	3	6 1/4	62 3/4	44	1 1/4	1.746	3726	1 1/4	4.45	3.19	1.26
56	2.27	2 1/4	1555	68 3/4	3	6 3/4	65	48	1 1/4	1.746	3674	1 1/4	4.26	3.19	1.07
58	2.34	2 3/4	1567	71	3 3/4	6 1/4	67 1/4	48	1 1/4	1.746	3941	1 1/4	4.40	3.19	1.21
60	2.41	2 3/4	1588	73	3 3/4	6 1/4	69 1/4	52	1 1/4	1.746	3892	1 1/4	4.19	3.19	1.00
62	2.47	2 3/4	1550	75 3/4	3 1/4	6 3/4	71 3/4	52	1 1/4	2.051	3538	2	4.34	3.41	0.93
64	2.54	2 1/2	1561	78	3 1/4	7	74	52	1 1/4	2.051	3770	2	4.48	3.41	1.07
66	2.61	2 3/4	1572	80	3 3/4	7	76	52	1 1/4	2.051	4010	2	4.60	3.41	1.19



MECHANICAL ENGINEERING DATA

SCHEDULE OF STANDARD PIPE FLANGES FROM 1 IN. TO 100 IN. FOR 125-LB. WORKING PRESSURE (Concluded)

Diameter of Pipe	$P = \text{Pressure per Sq. In. Thickness of Pipe} = \left[\frac{P + 100}{4 \times S} D + 0.333 \left(1 - \frac{100}{D} \right) \right] \times 1.2$ (S = 1800)	Minimum Thickness (Fractions of an In.)	Stress on Pipe per Sq. In.	Diameter of Flange	Thickness of Flange	Width of Flange Face	Diameter of Bolt Circle	No. of Bolts	Diameter of Bolts	Effective Area	Stress per Sq. In. on Bolt, Metal	Diameter of Bolt Holes	A	B	C
68	2.68	2 $\frac{1}{4}$	1582	82 $\frac{1}{4}$	3 $\frac{3}{8}$	7 $\frac{1}{8}$	78 $\frac{1}{4}$	56	1 $\frac{1}{8}$	2,051	3952	2	4.38	3.41	0.97
70	2.74	2 $\frac{3}{8}$	1591	84 $\frac{1}{2}$	3 $\frac{1}{2}$	7 $\frac{1}{4}$	80 $\frac{1}{2}$	56	1 $\frac{1}{8}$	2,051	4188	2	4.51	3.41	1.10
72	2.81	2 $\frac{1}{2}$	1600	86 $\frac{1}{2}$	3 $\frac{1}{2}$	7 $\frac{1}{4}$	82 $\frac{1}{2}$	60	1 $\frac{1}{8}$	2,051	4136	2	4.33	3.41	0.92
74	2.88	2 $\frac{3}{4}$	1609	88 $\frac{1}{2}$	3 $\frac{3}{8}$	7 $\frac{1}{4}$	84 $\frac{1}{2}$	60	1 $\frac{1}{8}$	2,051	4368	2	4.44	3.41	1.03
76	2.94	2 $\frac{1}{2}$	1617	90 $\frac{1}{4}$	3 $\frac{3}{8}$	7 $\frac{1}{8}$	86 $\frac{1}{4}$	60	1 $\frac{1}{8}$	2,051	4608	2	4.54	3.41	1.13
78	3.01	3	1625	93	3 $\frac{1}{4}$	7 $\frac{1}{8}$	88 $\frac{3}{4}$	60	2	2,302	4325	2 $\frac{1}{2}$	4.66	3.63	1.03
80	3.08	3 $\frac{1}{4}$	1633	95 $\frac{1}{4}$	3 $\frac{1}{4}$	7 $\frac{1}{8}$	91	60	2	2,302	4549	2 $\frac{1}{2}$	4.78	3.63	1.15
82	3.15	3 $\frac{1}{2}$	1640	97 $\frac{1}{4}$	3 $\frac{1}{2}$	7 $\frac{1}{8}$	93 $\frac{1}{4}$	60	2	2,302	4779	2 $\frac{1}{2}$	4.90	3.63	1.27
84	3.21	3 $\frac{3}{4}$	1647	99 $\frac{1}{4}$	3 $\frac{3}{8}$	7 $\frac{1}{8}$	95 $\frac{1}{4}$	64	2	2,302	4702	2 $\frac{1}{2}$	4.68	3.63	1.05
86	3.28	3 $\frac{1}{2}$	1653	102	4	8	97 $\frac{1}{4}$	64	2	2,302	4928	2 $\frac{1}{2}$	4.79	3.63	1.16
88	3.35	3 $\frac{3}{4}$	1660	104 $\frac{1}{4}$	4	8	100	68	2	2,302	4857	2 $\frac{1}{2}$	4.60	3.63	0.97
90	3.41	3 $\frac{1}{2}$	1667	106 $\frac{1}{4}$	4 $\frac{1}{8}$	8 $\frac{1}{4}$	102 $\frac{1}{4}$	68	2 $\frac{1}{8}$	2,648	4416	2 $\frac{1}{2}$	4.71	3.83	0.88
92	3.48	3 $\frac{3}{4}$	1643	108 $\frac{1}{4}$	4 $\frac{1}{8}$	8 $\frac{1}{4}$	104 $\frac{1}{4}$	68	2 $\frac{1}{8}$	2,648	4615	2 $\frac{1}{2}$	4.81	3.83	0.98
94	3.55	3 $\frac{1}{2}$	1649	111	4 $\frac{1}{4}$	8 $\frac{1}{4}$	106 $\frac{1}{4}$	68	2 $\frac{1}{8}$	2,648	4817	2 $\frac{1}{2}$	4.89	3.83	1.06
96	3.62	3 $\frac{3}{4}$	1655	113 $\frac{1}{4}$	4 $\frac{1}{4}$	8 $\frac{1}{4}$	108 $\frac{1}{4}$	68	2 $\frac{1}{8}$	3,023	4401	2 $\frac{3}{4}$	4.99	4.06	0.93
98	3.68	3 $\frac{1}{2}$	1661	115 $\frac{1}{4}$	4 $\frac{3}{8}$	8 $\frac{3}{4}$	110 $\frac{1}{4}$	68	2 $\frac{1}{8}$	3,023	4587	2 $\frac{3}{4}$	5.09	4.06	1.03
100	3.75	3 $\frac{3}{4}$	1667	117 $\frac{1}{4}$	4 $\frac{3}{8}$	8 $\frac{3}{4}$	113	68	2 $\frac{1}{8}$	3,023	4776	2 $\frac{3}{4}$	5.20	4.06	1.14



NOTES:—Bolt holes should straddle center lines. Flanges should be plain faced. Square head bolts with hexagonal nuts are recommended. For bolts 1 $\frac{1}{8}$ in. diameter and larger stud, with a nut, at each end is satisfactory. Hexagonal nuts for pipe sizes 1 in. to 46 in. can be conveniently pulled up with open wrenches of minimum design of heads. Hexagonal nuts for pipe sizes 48 in. to 100 in. can be conveniently pulled up with box or socket wrenches. Rules approximately followed in compiling above data:
 Bolt circle = 1.10 D + 3
 Flange thickness = 0.0315 D + 1.25 (for sizes 26 in. to 100 in.)
 D = inside diameter of pipe
 Flanges to be spot bored for nuts for sizes 32 in. to 100 in. inclusive.

CENTRIFUGAL PUMPS

If v_d be the velocity of flow along the discharge pipe of a pump, and if the loss of energy proportional to $(v_1 - v_d)^2$ be also taken into consideration (experiments on flow in diverging passages have previously established that if the sides in a circular pipe diverge at an angle of 6 deg., the loss of head including friction is about

$$0.13 \frac{(v_1 - v_d)^2}{2g}$$

and is greater for angles greater or less than 6 deg., amounting to

$$\frac{0.15 (v_1 - v_d)^2}{2g}$$

for usual angles of divergence in the volute chambers of pumps); let further $v_1 v_d = 3.85$, which is in close agreement with practice, then the total increase in pressure energy after leaving the impeller is given by

$$\frac{v_2^2}{2g} \left[(1-b) - \left(\frac{n}{m} \right)^2 \left\{ 0.15 + a \right\} \right] \text{ ft. lb. per lb.}$$

where m is the ratio of cross-sectional area of the volute at the point under consideration to the area of the stream leaving the impeller; v_2 is velocity of the impinging (deviated) stream, and the values of a and b are given by the formulæ

$$a = \frac{0.0052}{m} \theta^{1.28} \quad (\theta \text{ in deg.})$$

$$b = \left(\frac{m-1}{m} \right)^2 + \frac{0.00046}{m} \theta^{1.8}$$

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If n , which is the ratio of $\frac{Q_1}{Q_2}$ or the volumes in cu. ft. per sec. conveyed by the two streams, is known, then the known values of a and b enable the value of m for maximum gain of pressure to be calculated by successive approximations.

To facilitate the solution of practical problems, the values of θ or angle of impact between 0 and 20 deg. and of m from 1 to 28 have been examined, and m for maximum gain of pressure is given by

$$m = 1.10 + 0.14 n^2 + 0.0265 n \theta$$

[*Journal*, 1914, p. 019]

TWO-STROKE CYCLE OIL ENGINE

In a two-stroke cycle oil engine having distribution by means of ports, the total quantity of gas G which passes through the port during the entire period of the operation of the process of pressure equalization is given by

$$G = \int_{t=0}^t F. dt. \gamma. v. f(p_1, p_2, T)$$

where

v = coefficient of contraction

γ = specific weight

$f(p_1, p_2, T)$ is a function of pressure p and temperature T which, for par-

ticular cases, may be determined from the theory of the flow of gases
 $F \cdot dt$ = time cross-section available to the flow of the gas.

[*Journal*, 1914, p. 030]

BOILERS

In locomotive type boilers, the transference of heat is proportional to the square of $T_n - t$, difference between the temperatures of the heating gases and the boiler water, which leads to the following equation

$$(T_n - t) c_p (1 + L) \beta = \frac{a b \lambda}{b + \frac{H_n}{R}} = \theta_n b \lambda$$

where

T_n = temperature of furnace gases at n

t = temperature of boiler water

β = weight in kg. of coal burned per hour per qm. of the grate area

L = weight of air required to burn one kilogram of coal

$c_p = 0.25$, specific heat of heating gases

H_n = section of heating surface of boiler in square meters, measured from the grate up to the point n on that surface

R = grate area in qm.

θ_n = amount of steam generated per sq. meter of H_n per hour, in kilograms

a and b are constants, respectively equal to 788 and 6.15

λ = heat of evaporation.

[*Journal*, 1914, p. 041]

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GAS FOUNTAINS

The distance of flow of a fountain of hot air is given by

$$H = \frac{v^2}{2g} \cdot \frac{273 + t_n}{t_d - t_n} K$$

where

H = distance of flow of fountain in meters

v = initial velocity in meters

t_d = temperature of moving stream

t_n = temperature of surrounding stationary medium

K = a coefficient = 0.707.

[*Journal*, 1914, p. 0118]

AIR COMPRESSORS

The total work consumed in adiabatic compression, taking into account the suction pressure, is represented by

$$L_a = \frac{c_p (T_2 - T_1) G_s}{A} \text{ m/kg.}$$

Expressed in horse power

$$N_e = \frac{L_a}{75 \phi}$$

where

c_p = specific heat at constant pressure

T_1 and T_2 are absolute temperatures at initial and end pressures respectively

G_s = weight of air taken by the compressor per second.

A = mechanical equivalent of heat

$$= \frac{1}{427} \text{ m/kg.}$$

N_e = effective horse power

ϕ = mechanical efficiency.

[*Journal*, 1914, p. 0138]

AUTOMOBILE ENGINES

Using the following notation

i = number of cylinders

a = work of motor during its four cycles

n = revolutions per minute

d = cylinder bore

s = stroke

k = ratio of specific heats of mixture c_p at constant pressure and c_v at constant volume (may be taken as 1.13)

v = compression ratio (ratio of volume of gas at beginning and end of compression stroke)

H = heating value of fuel per kilogram (gasoline)

T_o = absolute temperature at beginning of compression stroke.

C_{vm} = average specific heat at constant volume

L = weight of air required for the combustion of one kilogram of gasoline

All the above quantities are in continental units.

η = coefficient of efficiency

= $\eta_g \cdot \eta_m$, where η_g is the quality factor and η_m the mechanical efficiency of the engine

Then the effective horsepower of an automobile engine is

$$N_e = \left(\frac{1 - \frac{1}{v^k}}{k - 1} \right) \cdot \frac{\pi d^2 s}{4} \cdot \frac{H}{T_o C_{vm} (L + 1)} \cdot \frac{i n}{9000} \eta$$

[*Journal*, 1914, p. 0142]

LOCOMOTIVE RESISTANCE

The traction on the rim of a locomotive is expressed by

$$F_R = \frac{P + Q}{Q} F_n + P (w_v - w_n)$$

where

$w_v = \frac{W_v}{P}$ = specific resistance of the locomotive as a carriage

$w_n = \frac{W_n}{Q}$ = specific resistance of cars

F_n is determined by means of a dynamometer

w_v and w_n have to be determined by separate tests

P = weight of locomotive and tender

Q = weight of cars
 W_v = resistance of locomotive and tender
 W_n = resistance of cars

$W_v = i - \frac{V_2 - V_1}{t_2 - t_1} \cdot 30$ gives the specific resistance at any point of the road, where

V_2 and V_1 = respective velocities at two points on the road
 t_2 and t_1 = respective times at the same point
 t = time
 i = incline in mils.

For a locomotive with a leading four-wheel bogie, the equation of specific resistance as a carriage may be taken as

$$W_v = 1.4 + 0.02 V + 0.005 V^2$$

and for a locomotive with a single leading axle

$$W_v = 1.3 + 0.01 V + 0.0005 V^2$$

Lomonosoff formulae for the resistance of cars:

$$W_n = 1.5 + 0.2 V \frac{V + 100}{1000} \text{ for summer traffic}$$

and

$$W_n = 1.5 + 0.5 V \frac{V + 10}{1000} \text{ for winter traffic}$$

In winter the resistance at the starting of a train is considerably higher than after the state of operation becomes normal.

[*Journal*, 1914, p. 0144]

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TURBINE PUMPS

In capitalizing the investment of centrifugal turbine pumps, the following formula has been derived

$$\frac{A W H P}{D} + F(i + d) + L + M = C$$

where

A = total gallons pumped per year
 W = weight of a gallon of water
 H = average total head in feet pumped against
 P = cost of steam per 1000 lb.
 D = average duty in ft.-lb. per 1000 lb. of steam
 F = total investment
 i = rate of interest on investment
 d = rate of depreciation
 L = yearly cost of operating labor
 M = yearly cost of miscellaneous expenses
 C = total cost per year.

[*Journal*, 1914, p. 0153]

GAS CONDUITS

For calculating cast-iron gas conduits, Aubéry has adopted the formula

$$h = 1.625 \frac{Q^{1.86} L}{D^{4.92}}$$

where

h = loss of head in mm. of water

Q = output in cu. m. per hour

L = length of conduit in meters

D = diameter in centimeters

corresponding to a density of gas equal to 0.44.

[*Journal*, 1914, p. 0177]

HARDENING OF STEEL

To determine the depth of cut to take when machining tool steel so as to remove the bark, use the following table which is developed by considering depth of bark as a function of temperature of hardening

Temp. of hardening deg. Fahr.	Depth of bark Inches
1370	0.015
1380	0.018
1390	0.018
1415	0.018
1435	0.021
1460	0.020
1490	0.024
1530	0.027

[*Journal*, 1914, p. 0199]

WORM GEAR DRIVE FOR WAGONS

Using the following notation

M_n = maximum moment of torsion transmitted in kg. per cm.

d = diameter of pitch circle of worm, in cm.

P = tangential pressure at pitch circle of worm in m. per kg.

P_1 = transmitted tangential effort at the pitch circle of worm wheel in m. per kg.

P_n = normal tooth pressure in kg.

α = angle of inclination in deg.

μ = coefficient of friction (=about 0.08)

η = efficiency of worm gear drive

Then, if the worm drives the gear

$$P = \frac{2M_n}{d}$$

where d can be determined graphically.

Further

$$P_1 = P \frac{\tan \alpha - \mu}{1 + \mu \tan \alpha}$$

The normal tooth pressure is

$$P_n = \frac{P}{\cos \alpha + \mu \sin \alpha}$$

The efficiency is

$$\eta = \frac{\tan \alpha - \mu}{\tan \alpha (1 + \mu \tan \alpha)}$$

The greatest sliding speed occurs when the worm runs at the speed n of the engine. The tangential pressure which then occurs at the pitch circle of the worm is

$$P_o = \frac{2M}{d}$$

where M is the moment of torsion of the engine

The normal tooth pressure is then

$$P_{on} = \frac{P_o}{\cos \alpha + \mu \sin \alpha}$$

The maximum tangential speed at the pitch circle of the worm is

$$v = \frac{\pi d N}{100 \times 60} \text{ meters per second}$$

where N = highest speed of the engine

The sliding speed is

$$v_g = \frac{v}{\sin \alpha}$$

[*Journal*, 1914, p. 6209]

MR. TOOKEY'S FORM FOR TABULATING DATA OF COMMERCIAL TESTS OF INTERNAL-COMBUSTION ENGINES

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Test No. 595A

Date: 13 Feb. 1913

Name: S. & Co

2 Meters: 300 It. No. 906089

Address: Bermondsey, S. E. (*London, Eng.*)

300 It. No. 37388

Assistant's Initials: A. R. P.

Machinery driven: Dynamo and cocoa-grinding plant.

24 × 30 (————) Gas Engine No. 10841.

R p.m. { Light: 155
Load: 154

Specific piston displacement $\left(\frac{A \times S.}{1728}\right) = 7.854$ cu. ft. per stroke

Governor: Hit-and-miss

I.h.p. constant $\left(\frac{A \times S.}{396,000}\right) = 0.03427$

Ignition: Two magnetos (low tension)

Piston positions from edge of liner—in-center: 23.375" in; out-center: 6.625"
out = 30" stroke

Exhaust valve setting { Open; piston 1" out; lead 5.625"
Close; piston 14.5" in; lag 8.875"

Mixture valve setting { Open; piston 22.75" in; lead 0.625"
Close; piston 3.875" out; lag 2.75"

Gas valve setting { Open; piston 20.5" in; lag 2.875"
Close; piston 6.25" out; early 0.375"

Compression pressure: 120 lb.

Compression pressure ratio $\left(\frac{C. P. + 15}{15}\right) = 9.0$

Volumetric efficiency: 0.876

Effective piston displacement: (Spec. P. D. \times V. E.) = 6.88

Clearance volume ratio $\left(\sqrt[1.3]{C. P. \text{ ratio}}\right) = 5.4$

Clearance volume $\left(\frac{E. P. D.}{C. V. R. - 1}\right) = 1.563 \text{ cu. ft.}$

Charge volume: 8.443 cu. ft.

Improvements obtained: power per impulse, 9 per cent; consumption, 10 per cent.

[*Journal*, 1914, p. 072]

PRESSURE FALL IN STEAM PIPING

The table below was derived by M. Guillaume for determining the proper dimensions of steam piping to secure the greatest economy of steam piping installations.

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DETERMINATION OF PRESSURE FALL IN STEAM PIPING

No. of Test	Duration of Tests, Min.	Average Pressure in Piping, Atmospheres Absolute	Average Temperature in Piping, Deg. Cent.	Average Volume of 1 Kg. (2.2 Lb.) of Steam in Cubic Feet (1 Cbm. = 35.314 Cu. Ft.)	$\gamma = \frac{1}{\rho}$	Steam, in Kg. per Hour	Velocity of Flow of Steam per Sec., in Piping 300 Mm. (12 in.) in Diameter, in M. (1 M. = 3.28 Ft.)	Pressure Fall in the Piping, $p_1 - p_2$, Atmospheres	L , length of Piping in M. (1 M. = 3.28 Ft.)	$w \gamma$	Coefficient of Resistance $\beta_1 = \frac{p_1 - p_2}{w^2 \gamma \frac{L}{d}}$
1	60	13.63	352.0	0.212	4.72	56887	47.35	0.1784	54.25	223.4	9.32×10^{-10}
2	60	12.42	353.0	0.233	4.29	52035	47.65	0.1587	54.25	204.6	9.02×10^{-10}
3	60	11.35	345.5	0.253	3.96	48111	47.73	0.1461	54.25	189.0	8.95×10^{-10}
4	60	10.20	345.8	0.282	3.55	43055	47.69	0.1368	54.25	169.2	8.39×10^{-10}
5	60	9.29	351.9	0.313	3.20	39200	48.13	0.1205	54.25	154.0	8.99×10^{-10}
6	60	8.18	338.4	0.348	2.88	35028	47.84	0.1076	54.25	137.7	9.03×10^{-10}
7	60	6.16	338.8	0.463	2.16	26571	48.33	0.0829	53.00	104.3	9.30×10^{-10}
8	60	7.17	340.2	0.399	2.51	30938	48.45	0.0927	53.00	121.6	8.91×10^{-10}
9	60	8.17	346.0	0.352	2.85	34842	48.14	0.1054	53.00	137.0	9.05×10^{-10}
10	60	8.18	348.0	0.353	2.83	34847	48.37	0.1066	53.00	126.9	9.15×10^{-10}
11	60	9.18	342.6	0.311	3.22	38850	47.47	0.1220	53.00	152.6	9.54×10^{-10}

[*Journal*, 1914, p. 0129]

DIRECTORY SECTION

**Mechanical Equipment
Directory**

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WITH this edition of the volume of Condensed Catalogues, the Classified Index appears in greatly enlarged form, under the new and properly descriptive title, *Mechanical Equipment Directory (Classified)*.

In its new form the Directory contains more than double the number of manufacturers' names carried in previous editions, together with the address of each firm. All the subject headings have been carefully revised and thoroughly cross-referenced; and every care has been taken to insure the listing of each firm under the proper headings only.

The Mechanical Equipment Directory is designed to meet the particular needs of the mechanical engineer and user of mechanical equipment in general. Containing as it does the names of nearly five hundred representative manufacturers, arranged and classified in such a way as to facilitate its use for purposes of quick reference, the Directory will be found exceedingly valuable whenever it is desired to locate readily the names and addresses of manufacturers of any given class of products in this field.

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